EVALUATION OF ADDISON COUNTY WASTERWATER DISPOSAL SYSTEMS

STATE OF VERMONT CONTRACT # 10923

November 19, 2007

HEINDEL & NOYES

Consulting Hydrogeologists, Engineers and Environmental Scientists

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Prepared for:

State of Vermont
Agency of Natural Resources

Prepared by:
Heindel and Noyes

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EXECUTIVE SUMMARY

In November 2006 the Agency of Natural Resources (ANR) solicited proposals from qualified consultants to carry out an investigation of operating wastewater disposal systems in Addison County. With significant rule changes governing wastewater disposal systems in the offing, the Legislature requested the ANR develop an assessment of existing systems operating on difficult soil conditions currently not permittable under the existing Wastewater System and Potable Water Supply Rules ("Rules") effective 1/1/05. Heindel & Noyes ("H & N") was selected to perform the evaluation, the results of which are reported on in this document.

Through the utilization of existing geographic information system ("GIS") data, H & N was able to create several data filters that resulted in the identification of "challenging" areas for wastewater disposal throughout the county. H & N then put forth 130 solicitations to community leaders requesting their assistance in performing the study through utilization of their existing wastewater disposal systems. Forty-seven (47) of these individuals responded positively to our request for assistance. Review of the officials' residential addresses as compared to the "challenging" wastewater disposal areas yielded nine (9) properties that met the criteria for further investigation.

Addison County based wastewater disposal system design companies were also queried and provided contacts for 43 sites they believed were located in "challenging" soils. Seventeen (17) of the property owners contacted from this list were willing to participate in this study.

In total, 27 wastewater disposal systems (one property owner owned two disposal systems studied) were evaluated. Measurements of the layout of the disposal systems on each site were collected and, when possible, the engineering drawings were obtained.

Ninety (90) groundwater monitoring wells were installed in soil borings placed within and downgradient of the wastewater disposal systems. Through the Spring of 2007 four hundred (400) groundwater elevation measurements were obtained via manual methods. Automatic dataloggers were utilized to collect an additional 37,000 water level readings. H & N also collected data regarding groundwater quality from several of the sites. An extensive survey was performed at each site to determine recent and historical water supply and wastewater disposal system usage, operation, and design. All the data collected throughout the study are presented and discussed in the following report.

Evaluation of the extensive database collected indicates that the majority of the wastewater disposal systems evaluated was “not failing” via the criteria set forth in the Rules (*i.e.*, no backup to the house, odors or evidence of surfacing effluent). The groundwater elevation and water quality data generally indicate that a sufficient thickness of unsaturated soil existed beneath the systems studied to result in effective effluent renovation and dispersal. The consistent and predicable effectiveness of these systems is likely a result of a commonality of design being utilized by the wastewater design professionals in the County. Our database indicates that the majority of the professionally designed systems fell within the following design parameters:

- Ground slope between 7-18%;
- Elevated “Mound” type disposal field;
- Pressure distribution to within mound;
- Linear loading rate using “Rules” based flow (150 gallons per bedroom per day) of less than 10 gallons per foot per day.
- Dispersal area size equal to approximately one gallon of effluent per square foot per day based on “Rules” flow rates;
- Basal area between 2,000-2,500 square feet;
- Curtain drain installed upgradient of the disposal field.

Additionally, our data clearly indicates that the volume of waters used per household, per person, and per bedroom are significantly less than those volumes required by the Rules

when designing disposal systems for State permitting. These low wastewater generation rates, coupled with the basic design parameters above, yield the positive results indicated in the water level and water quality data.

H & N believes that through the use of the basic wastewater disposal system design parameters detailed above and wastewater disposal system sizing based on the conservative wastewater flow volumes required by the Rules, that effective high-functioning wastewater disposal systems can be designed and operated over the long-term on the difficult soils seen throughout Addison County.

EVALUATION OF ADDISON COUNTY WASTEWATER DISPOSAL SYSTEMS

1.0 INTRODUCTION

Purpose of Evaluation: In November 2006 the Agency of Natural Resources ("ANR") solicited proposals from qualified consultants to carry out an investigation of active, operating wastewater disposal systems in Addison County. With significant rule changes governing wastewater disposal systems on large lots in the offing, the legislature requested the ANR develop an assessment of existing systems operating on difficult soil conditions currently not permittable under the existing Wastewater System and Potable Water Supply Rules ("Rules") effective date 1/1/05.

Challenges in Addison County: Addison County, by virtue of its geologic history, offers a number of challenges to siting wastewater disposal systems using the required design criteria in the Rules. In particular, fine grained soils, relatively flat terrain, shallow depth to bedrock, and significant yearly rainfall all lead to shallow groundwater conditions. Shallow groundwater limits the land area and type of disposal systems that can be permitted through the approaches described in the Rules.

Site Selection Process: This research effort set out to identify existing disposal systems which are situated with site conditions considered difficult or impossible to approve under the Rules. The site selection process involved first analyzing topographic conditions, geology, Natural Resources Conservation Service (NRCS) mapping, and hydrogeologic characteristics for the entire county through the use of geographic information system (GIS) technology. There are a number of published data sets which allowed us to identify expected site conditions based upon this mapping. Digital data of NRCS soil classifications, USGS topography, aerial photography, and surficial and bedrock geology are available for the county. Utilizing these available data sets, an array of filters was applied to the data to determine potentially challenging areas for wastewater disposal suitability. The filters applied to the data were based on common restrictions to wastewater

disposal system siting included in the Rules and NRCS classifications of on-site sewage disposal ratings, slope, estimated depth to water table, and estimated depth to bedrock.

NRCS Onsite Sewage Disposal Ratings: The map on Appendix 1 Page 1 shows the NRCS on-site sewage disposal ratings for Addison County. This map was created using NRCS data, and indicates the locations where septic tank absorption fields are well suited, moderately suited, marginally suited, not suited, or not rated. The review of the map shows that much of the County is marginally not suited for wastewater disposal systems. The basis for the suitability determination by the NRCS is included in the legend on the map.

NRCS Estimated Depth to Bedrock: The NRCS data was also used to evaluate areas with shallow depth to bedrock. The resulting map (Appendix 1, Page 2) shows areas with 0”-20”, 20”-40”, and 40”-60” estimated depths to bedrock surface.

NRCS Estimated Depth to Water Table: NRCS estimated depths to water table was also mapped. This map (Appendix 1, Page 3) shows the vast majority of the central and western portion of the county with less than 1’ to estimated water table. The bulk of this area with a shallow water table also corresponds with a depth to bedrock of greater than 40”.

NRCS Ground Slope: The representative slope of the ground surface is also mapped on Appendix 1, Page 4. As expected, much of the central and western portion of the County has slopes of less than 10%, while the eastern portion has slopes generally greater than 15%. The shallow slope areas correspond well with the shallow depth to water table.

NRCS Soil Texture: Attempts at mapping the surface soil texture from the NRCS data resulted in a highly complex and difficult to read map, due to the high number of individual map units. Therefore, NRCS soil textures and descriptions were used by H&N scientists to develop categories of “typical wastewater disposal characteristics”, described below.

H&N Typical Wastewater Disposal Characteristics: In an effort to reduce the complexity of the mapping,, Heindel & Noyes' scientists reviewed and rated all of the soil series reported for the County. Each soil series was rated by the scientists, using their experience regarding typical wastewater disposal capabilities. The table at Appendix 1, Pages 5-9 shows the NRCS soils series, as well as H & N's determination of the typical wastewater disposal capabilities for each soil type as "excellent," "moderate," "difficult," and "not likely" The "difficult" and "not likely" data were combined into a single "Challenging" category for the mapping shown at Appendix 1, Page 11. The H & N wastewater disposal characteristics site map generally identifies "challenging" soils in generally the same areas as the NRCS "marginally suited" to "not suited" on-site sewage disposal ratings shown on Appendix 1, Page 1.

Challenging Site Conditions: H & N then utilized the general information obtained from viewing each these mapping products to create a definition which identifies sites with "challenging" conditions for onsite wastewater disposal. The analysis identified site conditions which are challenging for onsite wastewater disposal as those with the following characteristics:

- Depth to water table of 0.1' - 1'; and
- Ground slopes less than 3% or greater than 30%, and
- Challenging soils as defined by H & N scientists.

The definition by H&N of the "challenging soils" is based on a review of the NRCS Soil Series, and H&N scientists' familiarity with the Series characteristics.

The areas where at least 2 of the 3 criteria were met were then mapped using the GIS system. The map on Appendix 1, Page 10 presents the countywide mapping of "challenging site conditions."

Representatives from each town were provided with a map showing the challenging soils locations, roads, and 911 addresses for their town. H & N requested that this map be reviewed and comments made as to the accuracy of the classifications. A representative "challenging soils" location map is included in Appendix 1, Page 12, for the Town of

Ferrisburgh. Several responses from Town officials were received regarding the accuracy of the GIS mapping. Each of the responses received indicated that the mapping accurately represented areas of the Town that contained the most challenging soils for development.

Selection Process of Individual Wastewater Disposal Systems: Because of the compressed timeframe to carry out the spring monitoring portion of the study, we developed a strategy whereby we first contacted town health officers, select board members, and planning commission members to request permission to evaluate their personal wastewater disposal systems. Of the 130 solicitations we sent to community leaders, 47 responded positively to our request for assistance. A copy of the typical contact letter is included in Appendix 1, Pages 13 - 14. Upon receiving a positive response to our request, H & N reviewed the 911 address of the official's property, to evaluate if it resided in the previously-defined areas with challenging site conditions. Of the 47 responses indicating a willingness to participate in the study, 9 properties were chosen for further investigation and evaluation as to their applicability for this study.

Telephone interviews were conducted with the property owners to determine wastewater system characteristics. The telephone survey template is included in Appendix 1, Pages 15 - 16. In several cases the wastewater systems were designed in accordance with the Rules and permitted by the VDEC. A subset of these systems were found to be "best fix" replacements of previously failed systems. When the telephone interviews revealed the systems were either unpermitted or permitted replacement systems, these properties were kept for inclusion in the field study.

Input from Disposal System Designers in Addison County: Following the initial community leader contacts, H & N then directly queried four wastewater disposal system designers in Addison County with records and designs going back two or three decades or more (Lincoln Applied Geology, Inc., Phelps Engineering, Ridge Consulting Engineers, and Vermont Contours). H & N requested that each firm review their files for wastewater disposal systems at sites that could not be permitted under the current rules and clients who would potentially be willing to participate in the survey. H&N gratefully acknowledges the

invaluable assistance provided by these firms: each of the companies presented at least 12 potential site contacts and design details. H & N reviewed the locations and design specifications for each of the systems and contacted the current property owners of 43 sites provided by these individual consultants. A total of 17 property owners from these lists were willing to participate in the study. H & N included each of these sites in the field study.

Access Agreements for Investigated Systems: By mid-April 2007, we were able to identify and gain access to 27 systems that were located on challenging soils. H & N entered into access agreements with each property owner assuring their anonymity (see example letter and access agreement in Appendix 1, pages 17 – 18).

Locations of Investigated Systems: The actual locations of the 27 investigated systems are shown "generically" on the map in Appendix 2, Page 1 ("Participating Sites [27]). To maintain confidentiality, this map only shows the large general locations of these sites. The sites are scattered throughout Addison County, in twelve of the 21 towns in the county.

General Geologic Characteristics of Investigated Systems: The soil conditions at the majority of the selected sites consisted of fine grained, poorly drained, lake bottom and or till derived sediments. Soil logs for the monitoring wells installed at each site describe soil textures between silt loam and clay. The consistency of much of the soil encountered was firm to hard. Structure of the soils ranged from granular to blocky. At nearly every site, evidence of seasonal high water table in the form of redoximorphic mottling was observed within twelve (12) inches of grade, and often within six (6) inches of grade. Native soil slopes ranged from 4 to 20%.

Characteristics of Investigated Systems: The selected sites include 25 septic-tank effluent systems (no advanced treatment) -- 18 mound type disposal systems, and 7 in-ground systems. The investigated systems also include 2 innovative pre-treatment systems.

With the assistance of individual landowners and design firms, we acquired the best available engineering data for each of the systems. When specific design information was not available we utilized our knowledge of wastewater system design and physical evidence on each site to estimate the size, construction method and piping distribution network orientation. Summary tables of the operational characteristics of the selected systems, including number of occupants, amount of water used, years of service, and basic design information, are included in Appendix 2, Pages 2 - 8. Each of the in-ground systems and several of the older mound type systems were fed via gravity distribution directly from the septic tank. However, the majority of the mound systems had pressure distribution provided by a pump station and were designed by certified wastewater disposal professionals. At least twelve of the study systems are known to be replacement systems for previously failed systems. Curtain drains were confirmed to be present at ten (10) of the study sites.

Water Usage Estimation: H&N made arrangements for the acquisition of daily flow measurements by metering or tabulation of water uses (see Water Use Estimate Survey form, Appendix 1, page 19). Summary tables of the operational characteristics of the selected systems, including number of occupants, amount of water used, years of service, and basic design information, are included in Appendix 2, Pages 2 - 8. Water usage at sites with metered water service was utilized to determine the estimated water usage at sites without metering. Metered households were asked to track their individual usage of utilities (toilet flushes, showers, dishwasher cycles, etc.) and to record meter readings. Using these data we were able to “calibrate” utility usage with the water volume recorded by the meter. For the purposes of this study the following water volumes were used for each utility use:

- Bath/Shower 20 gallons each
- Clothes Washer 25 gallons per load
- Dish Washer 15 gallons per load
- Toilet 3 gallons per flush

When these use volumes are applied to the metered home data the estimated water use volume is within 10% of the metered water use volume readings. The water usage at non-metered sites was calculated using the volumes above.

Monitoring Wells: With the cooperation of the landowners, locations for monitoring wells within and immediately downgradient of the disposal fields were agreed upon. At each site a minimum of three groundwater monitoring wells were installed utilizing hand auguring techniques. The soils encountered at each monitoring well location were descriptively logged . At well locations MW-1 through MW-3, a 1.5" diameter well consisting of 2.5' of factory slotted Schedule 40 PVC screen and riser was placed within the augured hole. The screened sections were sand-packed and a 6" bentonite seal was placed above the sand-pack. The remainder of the borehole was filed with native soil. Each of these three monitoring wells was installed at a similar location at each site. At well location MW-4 (where appropriate – see discussion below), a 1" diameter steel pipe was hammered into the distribution stone. The general locations and the well construction methodologies are described below. Soil boring logs for all of the sites studied are included in Appendix 3.

MW-1: This well was installed between the distribution bed and downgradient edge of mound/leachfield. This well was screened across the interface of the native soils and mound sand in mound disposal systems, and across the anticipated groundwater surface in in-ground disposal systems.

MW-2 and MW-3: These two wells were installed immediately downgradient of the toe/edge of the disposal area, and were terminated at 3.5 feet below grade.

MW-4: At locations where engineering drawings were available and field measurements indicated that the system was installed as designed, H & N installed one additional monitoring well within the distribution stone of the disposal area. Due to the difficulty of augering through the distribution stone, hand-auguring techniques could not be used to install this well. A 1" diameter steel pipe was perforated for one foot and a point placed on the end. This pipe was advanced using a sledge hammer to a depth where the perforated section overlapped the interface between the distribution stone and mound sand/native soil. In several cases, a hand-augured hole was first advanced to the top of the

leachfield stone prior to advancement of the MW-4 pipe. If this occurred, the hand-augured hole was bentonite sealed and backfilled with native soil.

Soil samples from interface between distribution stone and native fill or mound sand: At a number of locations where the engineering drawings and field measurements indicated the disposal system was installed as designed, H & N also attempted to obtain undisturbed soil samples from the distribution stone and native fill/mound sand interface. The purpose of collecting these soil samples was to evaluate them for the presence of a "biomat" at this interface, and to obtain a better understanding of potential surcharging and saturated/unsaturated flow from the dispersal trenches. The undisturbed samples were obtained by advancing a three-inch diameter split-spoon type sampler using a track-mounted walk-behind skid-steer. If the distribution stone and subsurface materials could be properly penetrated, the soil sample was removed and photographed, descriptively logged, and the sample hole was utilized for the placement of MW-4. H & N successfully obtained dispersal stone split-spoon samples at 7 sites. Photographs and soil descriptions are included in the individual site data in the Companion Binder.

Groundwater Depth Measurements: For two-week time periods through the spring 2007, datalogging water level measuring devices (pressure transducers) were installed in the monitoring wells. Additionally, manual measurements were taken through June 1, 2007. The data manually-collected are tabulated in Appendix 2, Pages 9 - 11. Manual and datalogger data are summarized graphically in the site-specific data included in the Companion Binder. Estimates of seasonal high water table in and beneath the waste disposal bed/trenches were considered crucial in establishing the efficacy of wastewater treatment for these sites. By knowing the depth to groundwater and the approximate elevation of the disposal beds within the disposal systems, it is possible to determine the unsaturated zone present during the monitoring operation.

Groundwater Quality Samples: Groundwater quality samples were collected from representative wells at several sites when sufficient water was present. If sufficient sample volume could be obtained, each sample was analyzed for total and dissolved phosphorous, nitrogen species (nitrate, nitrite, total Kjeldahl nitrogen, and ammonia), E. coli bacteria, total coliform bacteria, specific conductivity, and temperature. If limited sample volume was collected, deference was given to coliform bacteria, E. coli bacteria, and phosphorous analyses. These data were then used to determine the oxidation state of the wastewater during the soil treatment process. The water quality data are summarized in Sections 4.0 through 6.0 of this report, and in Appendix 2, Page 11. Individual lab reports of water quality results are in Appendix 4.

Discussion: The screening procedure for challenging site conditions and soil types, coupled with the physical and chemical quality data for each of the sites has provided an excellent opportunity to assess the performance of wastewater disposal systems on difficult sites. See Section 8.0 of this report. This research document will provide Vermont ANR with a basis for alternative assessments of waste disposal systems, and help to guide baseline design requirements for constructing systems on difficult soils.

Site-by-site Data Presentations: Section 3.0 of this report describes the data captured on each site and offers assessment and conclusions about its operational characteristics given the soil and hydrologic conditions defining the site. A Companion Binder is included, which presents the collected data by site number, allowing review of site-specific data while reviewing the site-specific text. For each site, we describe the physical setting the waste disposal system is situated in, the geology and hydrogeology of the site, details on the engineering of the system, and an overall assessment of the performance of the system. Where chemical data is available, we use this to compare and contrast the site's operation to the generally accepted performance standards the Rules are based upon.

Recommendations: We conclude the report by offering recommendations regarding engineering designs on sites with difficult soils (Section 9.0).

GIS Application: In addition to this report, we have compiled all the data so they can be viewed in an ARCview GIS software application. The compact disk provided with this report includes all of the data and project-related programming to allow for interactive data evaluation. The software allows for creation of independent queries of the data sets to assist in reviewing and analyzing the data collected. The details of the operational parameters of the ARCview project are not included in this report, but will be presented under separate cover. We have attempted to generate the databases and intrinsic programming to allow for expansion of the data set in the future, such as by the VDEC. Incorporation and utilization of data collected at difficult sites in the future will allow for continued expansion of the database, and will increase evaluation capabilities regarding overall design requirements and operational capabilities of disposal systems on difficult soils.

2.0 ANALYSIS AND ASSESSMENT OF INDIVIDUAL SITES

Included with this report is a separate bound document that includes all data collected during our study presented on a site-specific basis. This Companion Binder is to be utilized while reviewing the following report section. All data collected for each site, including soil boring logs, water level data, water quality data, generic or specific well location maps, and photographs are organized by site number (Site No.).

Site No. 7

1. Site Location and Description

Site No. 7 is located in Starksboro, Vermont. The site has had an on-site waste disposal system for 17 years, with the current residents having lived at this location for all 17 years. At the time of this survey three people occupied the four-bedroom residence.

The wastewater disposal system is an in-ground type, which is installed in silty fine sand glacial till that have been classified by the Natural Resources Conservation Service (NRCS) as extremely stony loam. Depth to mottling observed during our subsurface investigation was approximately 4" to 8" below ground surface. Test pit logs are indicative of glacial till soils. The surficial geology for the county classifies the parent material as glacial till (T). Bedrock at the study area has been classified as Pinnacle formation (Cp). The water supply for the residence is a drilled well which is not metered.

2. Disposal System Design and Use

The disposal system is comprised of a 1,000 gallon concrete septic tank which is connected to the wastewater disposal system. Due to the age of this system (17 years) the actual design of the leachfield is poorly documented. It appears that the leachfield area is approximately 20' X 90' and consists of 4' wide trenches placed 6"- 8" below grade. A curtain drain outlet was observed uphill of the system and was discharging in April.

Flow to the disposal system is generated by three occupants in a four-bedroom residence. The owners report the use of a washing machine, but do not have a dishwasher, garbage disposal unit, utility sink, or water softener. Our best estimate, based upon field observations, is that the average per square foot loading rate is 0.10 gallons per day per square foot (g/d/sq.ft.). We estimate the disposal area length to be 90'. Utilizing the residence bedroom count and current Rules based wastewater flows, a linear loading rate (LLR) of 5 gallons per day per linear foot (g/d/lin.ft.) was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 1 g/d/lin.ft.

While no surfacing has been observed by the owners, H & N observed wet areas and septic odors suggesting that this system experiences periodic failures due to the lack of significant unsaturated zone.

3.0 Groundwater Levels and Wastewater Loading

Groundwater levels during the spring high water period were established by monitoring wells installed within and downslope of the disposal system. A schematic showing the configuration of the monitoring wells is included in the Companion Binder. MW-1 is installed within the leachfield and MW-2 and MW-3 are immediately downslope. Depth to groundwater was established through periodic on-site measurements. These occurred on May 10, 16, 24, June 1, and 11, 2007. A water level datalogger installed in MW-1 operated continuously from May 1-16, 2007. The levelogger and manual measurements indicated groundwater levels reached their maximum on May 3 and May 6, 2007, achieving a depth of less than 0.3' below ground surface.

During the groundwater monitoring period, the disposal system was loading the site at an average of 97 gallons per day. The maximum daily water use during the monitoring period was 137 gallons per day. The average weekly disposal rate was computed to be 679 gallons per week. This is far less than the wastewater flows which would be generated by a "typical" four-bedroom home.

The combination of rainfall, snow melt, and system loading created a maximum observed groundwater elevation of approximately 0.41' below ground surface in MW-1. Because this is an in-ground system, it is likely that wastewater disposal trenches were submerged beneath the seasonal high groundwater surface during the high groundwater period. Personal observations by the residents have never noticed any surfacing, but "wet areas" and septic odors were reported by H & N.

Site No. 11

1. Site Location and Description

Site No. 11 is located in Starksboro, Vermont. The residence is eight years old, with two occupants in a three-bedroom home. The same owners have lived at this residence since it was first constructed.

The wastewater disposal system serving this home is an in-ground configuration with an absorption area of approximately 600 sq. ft.

The system is installed in mapped Berkshire soils, and was categorized during hand auguring for this study as very fine sand. The effluent transmission zone soils are firm with a granular structure. The system is located on a 10% slope. Depth to mottling was observed at approximately 6" below ground surface.

The surficial geology map for the area classifies the parent material as ice contact outwash gravels in a kame terrace (KT). The bedrock unit underlying the site is identified as Pinnacle formation (Cp). The water supply for the residence is a dug well installed in the shallow, unconsolidated aquifer. Flows from the well are not metered.

2. Disposal System Design and Use

Site No. 11's waste disposal system has a 1,000 gallon concrete septic tank which is connected to the (estimated) 600 sq. ft. in-ground system via a gravity pipeline. The septic tank has access through a manhole installed at ground level. The owners report that a design professional participated in the system location and layout. The present system has been in operation for eight years.

Flow to the system was generated by two occupants in the three-bedroom residence. The owners utilize a washing machine, dishwasher, and utility sink. There are no water

softeners or garbage disposal units. During the monitoring period, the disposal system was loading the site at an average rate of 113 gallons per day. The maximum daily water use recorded during the study period was 163 gallons per day, and the average weekly disposal rate was 792 gallons.

The best available information on the design of the system indicates that there is approximately 600 sq. ft. of waste disposal area. This results in an average application rate of 0.19 gallons per day per square foot. We estimate the disposal area length to be 50'. Utilizing the residence bedroom count and current Rules-based wastewater flows, an LLR of 8 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 2 g/d/lin. ft. Over the 8-year history of system operation, no incident of surfacing, ponding, septic odors, or septic backup has been observed.

While there are no water quality data for the site, probable system construction and unsaturated soils observed during the monitoring period suggest appropriate treatment is taking place.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the spring high water period were established by periodic measurements of hand-installed monitoring wells, along with continuous monitoring over a two-week period. The schematic location of the monitoring wells is shown on the site plan in the Companion Binder.

MW-1 was installed in the leachfield, and MW-2 and MW-3 are downgradient from the waste disposal area. Individual checks on the monitoring wells in May and June showed no groundwater in any of the wells to a depth of 3.5' (+/-) below ground surface. Continuous monitoring of the site occurred from April 18 through May 13, 2007 in MW-1, and showed no groundwater within 3' of the ground surface.

The combination of rainfall, snow melt, and loading from the disposal system was not sufficient to raise groundwater within the monitoring depth of 3.5' below ground surface.

In view of the fact that this is an in-ground system and more than 3' of separation distance was observed during the study, it is likely that a significant separation distance between the leaching bed and groundwater was maintained throughout the spring high water period.

Site No. 13

1. Site Location and Description

Site No. 13 is located in Bridport, Vermont. The waste disposal system is a mound design which was installed by a certified professional. The system is installed on Farmington Stony Loam soils. The soil borings encountered firm, blocky, silty clay. Depth to mottling has been identified from 4" below ground surface.

The surficial geology map classifies the parent material as Lacustrian. The bedrock unit underlying the site is identified as the Stony Point formation. Water supply for the residence is provided by the Tri-Town Water District and is metered. Slopes in the vicinity of the disposal system are approximately 14%.

2. Disposal System Design and Use

Site No. 13's disposal system is comprised of a 1,000 gallon concrete septic tank and a gravity-fed mound wastewater disposal system. The best estimate of system construction indicates a basal area of approximately 3,224 sq. ft. To the best of the owners' knowledge, the system was installed in accordance with the design professional's drawings. The present system has been in use for 31 years, being installed circa 1976. The owners have not observed any surfacing, wet spots, ponding, or septic odors from the system's operation.

Flow to the disposal system is generated by two residents in the three-bedroom residence. The owners utilize a washing machine, dishwasher and garbage disposal, but no utility sink or water softener. As flows to this system are metered from the municipal source, reliable measurements of water use have been acquired. The average daily use is 50.7 gallons per person per day. The average total use is 101 gallons per day, with a weekly disposal rate of 710 gallons. A maximum rate of 195 gallons in a single day was noted.

Using the assumed system design and measured water use, the mound system application rate is 0.10 g/d/sq. ft. and the basal average loading rate of 0.03 g/d/sq. ft. While the building is designed with three bedrooms, the two occupants generate only a fraction of what the Rule-dictated loading rate would be for a three-bedroom facility. We estimate the disposal area length to be 52 feet. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 8 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 2 g/d/lin. ft.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the spring high water period were established by three monitoring wells installed for this study. MW-1 was installed outside of the disposal area within the mound fill. MW-2 and MW-3 were just outside the toe of slope.

Manual water level measurements taken on six occasions between April 23 and June 11, 2007, show that groundwater was below the depth of measurement, except on April 23 in MW-3 where it was identified at 2.94’ below ground surface. A period of continuous monitoring that occurred from April 18 to June 11, 2007, from MW-1. Groundwater was not measured as present by the datalogger.

In view of the mound system design and the separation distance observed in the monitoring wells throughout the period, it is very likely that this system had an unsaturated zone separating the disposal area from groundwater throughout the period of study.

Site No. 18

1. Site Location and Description

Site No. 18 is located Salisbury, Vermont. The waste disposal system serving this property is a Presby Enviro-Septic (Presby) disposal system. The disposal system is situated on Farmington soils. The soil borings confirmed the presence of the sandy, silty, loam, friable, soil type. The structure of the soil underlying the disposal system has been classified as blocky. Test pit logs and well locations are included in the Companion Binder.

The surficial geology map indicates lake bottom sediments (silt, silty clay, and clay). The bedrock unit in this area is identified as the Chipman Bridport and Belden's formation/Dolomite. Water supply for the residence is a drilled bedrock well that is not metered.

2. Disposal System Design and Use

Site 18's waste disposal system is comprised of a 1,000 gallon septic tank connected in series to a 1,000 gallon pump station that delivers wastewater to the Presby mound system. The design of the system was provided by a professional recognized by the State. The system has been in operation for four years and is surrounded with a perimeter drain. The drain was observed on several occasions and no flowing water was seen. Through the four years of operation, the owners have not observed surfacing, pooled areas, or any septic odors.

Flow to the disposal system is generated by two occupants in a two-bedroom house. There is a dishwasher, and washing machine connected to the system. A water softener is present. Backwash is discharged to a perimeter drain.

Plans were not available. However, estimating the length of the system in the field it is assumed that the disposal area is 900 sq. ft. We estimate the disposal area length to be 60'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 7 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 2 g/d/lin. ft.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the spring high water period were established by monitoring wells installed within and downslope from the waste disposal system. A total of three wells were placed on site to monitor subsurface conditions. A datalogging water level recorder was used from April 17 to 23 and April 25 to May 11. As the hydrograph illustrates (see Companion Binder) no water was recorded at any time during the monitoring period. Manual water level measurements taken on seven occasions in May and early June also indicate that all monitoring points were dry to depth for the period. This means that groundwater was generally greater than 3.25' below ground surface.

During the groundwater monitoring period the disposal system was loading the site at an average of 105 gallons per day. The maximum daily use recorded during our assessment was 108 gallons per day. The average weekly use is estimated to be 734 gallons. The combination of rainfall, snow melt, and waste system loading created a groundwater mound that was more than 3.25' below ground surface. Because the wastewater disposal system is located above ground surface (Presby in a mound system), the disposal surface was well above the seasonal high water table. Given the occupancy and daily water use the loading rate to this system is well below the design metrics. The absence of a water table within 3' of the ground surface illustrates that wastewater loaded to the site is likely undergoing excellent treatment. There is no water quality data available for this site due to the absence of water in the monitoring system.

Site No. 25

1. Site Location and Description

Site No. 25 is located in Weybridge, Vermont. The waste disposal system is a mound type and is installed in Nellis Stoney Loam. Hand-augured borings indicate silt loams with a firm, blocky structure. Depth to mottling is recorded at 6" below ground surface. The hand auger logs note localized zones of saturation associated within the wastewater disposal system (see test log for MW-2).

The surficial geology map classifies the parent material as lake bottom sediments. Bedrock is classified as the Middlebury and Chazy limestones. Water supply for the residence is a drilled well with a water meter on the system.

2. Disposal System Design and Use

Site No. 25's wastewater disposal system is comprised of a 1,000 gallon concrete septic tank connected in series with a 1,000 gallon pump station that delivers wastewater to a mound-type disposal system. A design professional provided the layout prior to construction. The system has been in operation for seven to eight years, replacing a previous system that was on the site. The owners have not observed any evidence of surfacing, ponding conditions, or septic odors. The disposal system also accepts discharge from a washing machine and dishwasher. There is a water softener on the system. The discharge location for the backwash is not known.

The field measurements indicate the system has a dispersal area of 629 sq. ft. and a basal area of approximately 1,500 sq. ft. The average disposal area application rate is estimated at 0.27 g/d/sq. ft with basal area application rates estimated to average 0.112 g/d/sq. ft.. We estimate the disposal area length to be 67'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 6 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 3 g/d/lin. ft.

No water quality data were acquired from groundwater around the system because the site was dry on all occasions when H & N staff accessed the property.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the spring high water period were established by monitoring four wells within and downslope from the disposal system. Groundwater depths for the site are compiled in the Companion Binder. Manual measurements were acquired on six individual dates. In addition to this, continuous monitoring of the site was carried out from April 18 to May 10. As the water level measurements and hydrographs show, groundwater was not observed in any of the monitoring points to a depth of 2.92'-6.75' below ground surface.

While groundwater was not observed, the borings on site indicate soils were near saturation at MW-1, the well installed within the wastewater disposal system.

During the groundwater monitoring period the four-resident/three-bedroom disposal system was loading the site at an average of 168 gallons per day. The maximum one-day use was recorded at 175 gallons per day. The average weekly disposal rate was 1,178 gallons.

The combination of rainfall, snowmelt, and system loading did not raise groundwater to the point where it could be recorded. However, as noted above, in the area where wastewater was being loaded to the system, soils were at incipient saturation. Because of this it is likely that Site No. 25 has an appropriate unsaturated zone to provide treatment. No water quality data could be acquired because all wells were dry during monitoring.

Site No. 28

1. Site Location and Description

Site No. 28 is located in Weybridge, Vermont, and is an in-ground type waste disposal system that was installed in Vergennes clay soils. Soils encountered are firm, blocky, clay to loam on an 11% slope. Depth to mottling was recorded at approximately 4" below ground surface. MW-1 was advanced immediately downgradient of the waste disposal bed and indicates typical septic odors. MW-2 and MW-3 were installed at the downgradient edge of the leachfield. MW-4 was installed within the distribution bed.

The surficial geology map classified the parent material as lake bottom silt and clays. The bedrock is mapped as Monkton quartzite. Water supply for the residence is provided by a drilled bedrock well that is not metered.

2. Disposal System Design and Use

Site No. 28's waste disposal system is in ground with an approximately 840 square foot dispersal area. There is a 1,000 concrete tank that delivers effluent via gravity flow to the disposal area. We estimate an average loading rate of 0.13 g/d/sq.ft. We estimate the disposal area length to be 30'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 19 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 4 g/d/lin. ft.

It is unknown if a design professional was involved in the analysis of system location or layout. In the 26 years of operation, there have been no reports of ponding, surfacing or septic odors. Flow to the disposal system is generated by two occupants from a five-bedroom home. A water softener, dishwasher, and washing machine are connected to the disposal system. The water softener discharges backwash to the septic tank. No water quality samples were available from this site, as the groundwater was below the elevation of

the monitoring wells. Considering the undocumented design of the system and depth to groundwater, it is likely that there is an unsaturated zone below the disposal system.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the spring high water period were established by monitoring wells installed within and downslope from the waste disposal system. Site No. 28 was visited on five occasions beginning on May 10 and ending June 11. Continuous monitoring of the site occurred from May 1 to 16. During that timeframe there was no groundwater observed in any of the monitoring points within or adjacent to the system.

During the monitoring period the average effluent loading to the system was 113 gallons per day. The maximum daily use was recorded at 174 gallons per day. The average weekly disposal rate was 790 gallons. This waste volume was generated by two individuals in a five-bedroom home.

The combination of rainfall, snowmelt, and system loading kept groundwater at least 2.91' below ground surface and as much as 4.08' below ground surface. Comparing the in ground system's likely design with depth to groundwater, we believe an unsaturated zone was maintained below the disposal bed, despite the mottling observed at 4" below ground surface.

Site No. 40

1. Site Location and Description

Site No. 40 is located in Shoreham, Vermont. The waste disposal system is an in ground type. The system is installed in Farrington silt loam type soils. Soil boring logs indicate firm silty clay texture with a granular-type structure. Depth to mottling is 4" below ground surface. The site likely has an undulating bedrock surface as weathered shale chips were evident in the hand augur borings. The surficial geology map classifies the parent material

on this site as glacial till (T). The bedrock is mapped as Iberville formation. Water supply for the residence is provided by Town water that is metered.

2. Disposal System Design and Use

Site No. 40's wastewater disposal system is comprised of a 1,000 concrete, ledge-type septic tank. Flow from the septic tank moves by gravity to a subsurface disposal system. A design professional was not involved in locating the system and analyzing the site. The system has been in use for six years by the present owners who have had four occupants in the four-bedroom house. They have not observed surfacing, ponding, or noxious septic odors during this time. A dishwasher and washing machine are used. There is no water softener, garbage disposal, or utility sink.

The best estimate of the design indicates an average disposal area loading rate of 0.77 g/d/sq. ft. of the 680 square foot bed. Although daily flows are relatively low, shallow groundwater conditions are proximal to the base of the leaching bed. We estimate the disposal area length to be 75'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 7 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 2 g/d/lin. ft.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the spring high water period were established by a series of three monitoring wells installed within and downslope of the waste disposal system. Groundwater depths for this facility are compiled in Appendix 2 and the Companion Binder. Manual water level measurements were acquired on four occasions between May 11 and June 11. Groundwater depths from the manual measurements range from 0.77'-2.42' below ground surface. A continuous record of groundwater elevations was also acquired from June 16 to 31. These data showed groundwater elevations in MW-1 varying from approximately 1.75'-2.75' below ground surface (see Companion Binder). On this particular

site groundwater conditions would be considered very shallow for an in ground type waste disposal system.

During the groundwater monitoring period the disposal system was loaded at an average rate of 129 gallons per day. The maximum single-day use was recorded at 160 gallons per day, with an average of 906 gallons weekly flow.

The combination of rainfall, snowmelt, and system loading kept groundwater levels relatively shallow, ranging from 0.77'-2.5' below ground surface. Because this is an in ground type system, it is likely that there was little, if any, separation distance between the disposal system and groundwater during the period of observation.

Site No. 43

1. Site Location and Description

Site No. 43 is located in Ferrisburgh, Vermont. The waste disposal system serving this property is a mound type. It rests on Vergennes clay soils. Soil borings revealed silt loams with firm consistency and blocky structure. Ground slope is approximately 15%. Depth to mottling is typically within 3" of the ground surface. The surficial geology map classifies the parent material as lake bottom silts and clays. The bedrock is mapped as Middlebury and Chazy limestones. Water supply for the residence is a drilled bedrock well.

2. Disposal System Design and Use

Site No. 43's mound type disposal system has a 1,500 gallon septic tank followed by a 1,000 gallon pump station that delivers effluent to the mound wastewater disposal system. Based on the existing plans, the dispersal area is 1,200 sq. ft. and the basal area for this system is approximately 4,000 sq. ft. The average basal loading rate is 0.04 g/d/sq.ft. A 0.15 g/d/sq. ft. application rate to the mound bed is calculated. The disposal area length is 85'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR

of 8.2 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 2 g/d/lin. ft.

A design professional was involved in the layout and assessment of the mound. The system has been in use for 8 years. Over that period of time the owners have not reported any surfacing, ponding, or noxious septic odors. A washing machine and dishwasher also discharge to the system. A water softener is used to condition the bedrock water supply. The backwash is discharged to the septic system. No water quality samples were acquired from this location.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the spring high water period were established by monitoring wells installed within and downslope of the mound waste disposal system. Groundwater observations are compiled in Appendix 2 and the Companion Binder. Manual water level measurements were taken on April 23 and six occasions in May and June. These data showed that groundwater ranged from being nearly at ground surface in MW-3 on April 23 to greater than 3.25' in MW-1 throughout late May and June. A continuous water level recording device was operated from May 3 to 24 in MW-1. This revealed groundwater elevations varying from about 1.75'-3.5' below ground surface.

Comparing groundwater elevations to the system design (mound), it is likely that the waste disposal bed maintained an unsaturated zone throughout the monitoring period. It appears that the induced groundwater mound did enter the mound sand. During the study period, the disposal system was loading the site at an average of 178 gallons per day. The maximum one-day use was 209 gallons. The average weekly loading rate was computed to be 1,246 gallons. These flows were generated by five occupants in a seven-bedroom home.

Site No. 46

1. Site Location and Description

Site No. 46 is located in New Haven, Vermont, and is serviced by a mound type disposal system. The mound is situated on Vergennes clay soils. Soil borings indicate clays with hard consistency and blocky structure. Depth to mottling is approximately 3" below ground surface. The disposal system is located on a 3% slope.

The surficial geology map of the site identifies the parent material of being of glacial till (T) origin. The bedrock is mapped as Dunham dolomite. The water source serving the residence is a drilled well. The well is not metered.

2. Disposal System Design and Use

Site No. 46's system is comprised of a 1,000 gallon concrete septic tank which delivers effluent to a 1,000 gallon pump station that pressurizes flow and delivers it to the mound disposal system. A curtain drain is present but was not observed flowing while H & N was on site. Best available data indicates the mound has a basal area slightly in excess of 1,700 sq. ft. and wastewater is applied at approximately 0.05 g/d/sq. ft. The 440 sq. ft. dispersal area receives wastewater at a rate of 0.18 g/d/sq. ft. We estimate the disposal area length to be 100'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 4 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 1 g/d/lin. ft. A design professional was involved in the location and specification of the system.

A washing machine, dishwasher, and utility sink are also attached to the system. There is no garbage disposal. A water softener is used to condition potable water prior to use, with backwash discharge to a perimeter drain. The system has been in operation for eight years. The owners have not reported any surfacing, ponding, or septic odors associated with the system.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the study were established by monitoring in four wells that were installed within and adjacent to the wastewater disposal system. Manual measurements occurred in late April and on five occasions in May and June. Only the April manual measurements indicated shallow ground water on the site ranging from 1.75'-2.99' below ground surface. After that, all wells were dry to a depth of 3.5' to 4.0' below ground surface, except MW-1. On May 6 and 7 when groundwater was measured at 3.25' below ground surface.

Continuous water level monitoring on the site occurred from April 19 to May 10 in MW-1. The hydrograph revealed a relatively "flashy" response of the groundwater system to precipitation and melt events. Groundwater elevations did enter the mound sand, but remained one foot below the distribution stone. When a groundwater elevation rise occurred, water levels receded very quickly.

During the groundwater monitoring period the disposal system loaded the site at an average of 77 gallons per day. The maximum individual day was determined to be 120 gallons. The average water use per week was approximately 540 gallons. These flows were generated by two occupants in a three-bedroom home.

The combination of rainfall, snow melt, and system loading raised groundwater to a minimum of about 1.75' below ground surface. Because the waste disposal system bed rests well above the seasonal high water table it is likely that this system is providing adequate treatment. No water quality data is available for this site.

Site No. 48

1. Site Location and Description

Site No. 48 is located in Shoreham, Vermont, and is served by an in-ground type wastewater disposal system. The site is underlain by Vergennes clay soils. The soil type has a firm consistency and blocky structure. Mottles are typically recorded within the first 3" of the ground surface. The disposal system site is situated on a 7.5% slope.

The surficial geology map classifies the parent material as lake bottom silt and clay. The bedrock is mapped as the Whitehall formation. The water supply for the residence is from a drilled well and is not metered.

2. Disposal System Design and Use

Site No. 48's in-ground disposal system is comprised of a 1,000 gallon concrete septic tank which delivers effluent via gravity to the leaching bed. The dispersal area of the system is estimated to be 612 sq. ft. based upon on-site physical features. We estimate the application rate to average 0.16 g/d/sq. ft. to a maximum of 0.28 g/d/sq. ft. of dispersal area. We estimate the disposal area length to be 77'. Utilizing the residence bedroom count and current Rules-based wastewater flow is 5 g/d/lin. ft. However, the LLR based on water survey estimated use during this study is calculated to be 1 g/d/lin. ft. The owners did not know if a design professional was involved in the installation of the system.

A washing machine and dishwasher are also attached to the system. There is no garbage disposal or utility sink. A water softener is used to condition potable water and discharges backwash water to the septic system. The system has been in operation for approximately five years. The owners have not reported any surfacing, ponding, backups, or noxious septic odors associated with the system. There is no water quality information for this site.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the study period were established by three monitoring wells located within and immediately downslope of the waste disposal system. Groundwater depths for this site are compiled in the attachments.

Manual measurements and continuous water level measurements were taken on this site. On April 23 and five other occasions in May and June manual measurements of the three monitoring wells were acquired. When water levels were measurable, they generally ranged from 1.8’ to 4.3’ below ground surface. Continuous water level measurements were taken on site from April 20 to May 11 in MW-1. Over that period of time, groundwater consistently varied from 3.5’-4.5’ below ground surface. Daily variations in water level elevations were approximately 0.25’-0.5’.

Over the period of study, the disposal system loaded the site at an average of 99 gallons per day. The maximum daily rate was recorded at 170 gallons in one day. The average weekly loading to the system was 692 gallons. These flows were generated by two individuals occupying a three-bedroom residence.

The combination of rainfall, snowmelt, and septic loading raised the water table to within 2’ of the ground surface for a limited period of time. Because of the depth to water table and considering it is an in ground system, it is likely that there was a limited separation distance for treatment during high groundwater periods. However, after spring runoff, it is likely that an unsaturated zone is maintained on this site. The blocky nature of the Vergennes clay soil and the 7.5% slope likely enhance drainage potential accounting for the homeowners’ qualitative observations of no significant failure issues.

Site No. 49

1. Site Location and Description

Site No. 49 is located in Middlebury, Vermont. The residence is served by an innovative pre-treatment system (Advantex) and mound type waste water disposal system. The disposal system is situated on Vergennes clay soils. The soil borings show a silt loam with a firm consistency with blocky structure. Mottling was described as being 6" below ground surface with the system installed on an 8% slope. The surficial geology map classifies the parent material as lake bottom silt and clay. The bedrock is mapped as Whitehall formation. Water for the residence is supplied by a drilled well and is not metered.

2. Disposal System Design and Use

Site No. 49's mound type wastewater disposal system is comprised of an Advantex pre-treatment package, a 1,000 gallon septic tank, and a 1,000 gallon pump station recirculation tank that delivers effluent under pressure to the mound type system. A curtain drain is present, but was not observed as flowing by H&N. The system was designed by a professional and has been in service for five years. The owners have never observed indications of failure such as ponding, surfacing, or noxious septic odors. A washing machine, dishwasher, and utility sink drain into the septic tank. There is no garbage disposal. The water softener discharges to a separate drainage system.

The available design plans indicate that the dispersal area is 400 sq. ft. and has 1,250 sq. ft. basal area. Wastewater is dosed at an application rate of 0.10 g/d/sq. ft. of basal area. Based upon the layout of the system, we estimate the average trench loading to be approximately 0.32 g/d/sq. ft. We estimate the disposal area length to be 50'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 8 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 3 g/d/lin. ft.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the spring high water period were established by three monitoring wells. These wells were installed within and downslope of the disposal system. Locations are schematically identified in the Companion Binder. Groundwater depths were manually measured on six occasions between April 23 and June 11. On all occasions there was abundant evidence of shallow groundwater on the site. Groundwater depths ranged from 1.14' to 3.83' below ground surface. An automatic water level recorder was installed on April 19 and measured groundwater levels continuously to May 5. During that time water levels ranged from 2.5'-3.75' below ground surface. The hydrographs for the water level measurements are in Companion Binder.

During the groundwater study the system was loaded at an average rate of 127 gallons per day. The maximum recorded flow was 237 gallons on one day. On average the system processed 889 gallons of wastewater per week. These flows are generated by three occupants in a three-bedroom home.

The combination of rainfall, snowmelt, and system loading raised groundwater to 1.14' from the ground surface in MW-3 on April 23. Groundwater elevations for the balance of the study were generally greater than 2' from the ground surface. In view of the fact that this is a filtrate mound disposal system, it is likely that an appropriate separation distance was maintained throughout the study period despite an induced groundwater mound entering the mound sand.

Groundwater samples were obtained from this site. Due to a limited volume of water available, not all of the constituents could be examined. The water quality data is summarized in Appendix 2, Page 11, and the Companion Binder. The lack of E. coli in the sample (see attachment) demonstrates that there is appropriate treatment by the wastewater disposal system. Based on the depth to groundwater and the mound system/Advantex design, we are confident that this site is providing appropriate effluent renovation.

Site No. 50

1. Site Location and Description

Site No. 50 is located in New Haven, Vermont, and is a mound type system installed on Vergennes clay soils. The soils encountered were a silt loam texture with blocky structure. Mottles were observed within 4" of the ground surface. The waste disposal site is located on a 7% slope. The surficial geology map classifies the parent material as lake bottom silt and clay. The bedrock is mapped as the Chipman dolomite. The potable water supply for the residence is a drilled well that is not metered.

2. Disposal System Design and Use

Site No. 50's wastewater disposal system is comprised of a 1,000 gallon concrete septic tank which drains via gravity to a 1,000 gallon pump station which pressurizes the mound wastewater disposal system. Based upon the available site plans, the basal area for this system is approximately 1,272 sq. ft. leading to an average basal application rate of 0.04 g/d/sq. ft. The layout of the system indicates a dispersal trench application rate of 0.11 g/d/sq. ft. We estimate the disposal area length to be 50'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 8 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 1 g/d/lin. ft. A professional provided the system design. The system was installed in 2000 and has operated for seven years. The owners have never observed surfacing, ponding, system back-up, or septic odors.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the spring high water period were established by four monitoring wells installed within and downslope of the disposal system. Groundwater elevations for this site are displayed in the attachment. Manual measurements of water

levels were acquired on six dates between April 23 to June 11. Continuous groundwater presence in MW-2 and MW-3 was observed until May 24, after which all monitoring devices were dry. Water levels were a minimum of approximately 1' below ground surface at the toe of the mound and, during the dry period, approximately 3.42' below ground surface.

Continuous monitoring on the site occurred from May 10 to 24. The hydrograph for MW-1 reveals the water table was more than 3.25' below ground surface for the entire period. There was no response to individual rainfall events or loading from the system. During the on-site monitoring events, the disposal system was loading the site at an average of 55 gallons per day. The maximum application was 72 gallons in one day. During the study the average weekly flow was 386 gallons. These wastewater flows were generated by two individuals living in a three-bedroom house. In addition to the black water loading, gray water from a washing machine, dishwasher, and garbage disposal unit were also adding to the septic tank liquid and chemical load. There is a water softener used on the water supply that also discharges backwash water to the septic tank.

The combination of rainfall, snowmelt, and system loading raised the groundwater level to a minimum recorded depth of 1.02' below ground surface. Because this is a mound type disposal system, we expect adequate unsaturated soil thickness was maintained throughout the period of study to renovate wastewater.

Site No. 52

1. Site Location and Description

Site No. 52 is located in Weybridge, Vermont. The mound type system is installed on Vergennes clay soils. Soil borings described sandy loams with a friable, granular structure. Depth to mottling has been recorded at 4" below ground surface. Local slope measurements indicate the system is installed on an 18% grade.

The surficial geology map classifies the parent material as lake bottom silt and clay. The bedrock is mapped as Monkton quartzite. Water supply for the residence is provided by a drilled well that is not metered.

2. Disposal System Design and Use

The wastewater disposal system is comprised of a septic tank of unknown size. Flow from the septic tank is to a pump station of unknown volume. From here the effluent is pressurized and sent to a mound disposal area with a basal area of approximately 2,000 sq. ft. Best available data indicates that the basal area loading rate is 0.06 g/d/sq. ft. The assumed dispersal trench/bed is approximately 500 sq. ft. and is loaded at 0.25 g/d/sq. ft. We estimate the disposal area length to be 50'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 8 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 2 g/d/lin. ft.

A washing machine, dishwasher, and garbage disposal are also treated by the on-site system. There is a water softener, but the ultimate discharge of the backwash is not known.

It is estimated that the system has been in service for 14 years. Over that period of time, the residents have never observed any ponding, surfacing, or noxious septic odors.

3. Groundwater Level and Wastewater Loading

Groundwater conditions recorded during the spring high water period were established in three monitoring wells. Site No. 52 had continuous saturation recorded in all wells from April 23 to June 11. The groundwater elevations were 0.43' below ground surface in MW-3 and up to 4.24' below ground surface in MW-1. A continuous water level measurement device was installed in MW-1 from May 10 to 24. This indicates groundwater elevations varied from approximately 3'-4' below ground surface, displaying a hydrograph with gently undulating surface, responding to on-site loading and incremental precipitation events.

During the groundwater monitoring period the disposal system was loading the site at an average of 124 gallons per day. The average weekly loading rate was 870 gallons. At this three-bedroom residence wastewater flow is generated by three occupants. The combination of rainfall, snowmelt, and system loading generates groundwater elevations from 0.5' to greater than 3' below the ground surface. An unsaturated zone of at least one (1) foot was maintained below the leaching bed allowing for effluent renovation.

Groundwater samples were collected on May 28 from MW-1 located within the disposal system and MW-2 downslope from the waste disposal area (Appendix 2, Page 11; Appendix 4; and Companion Binder). These data indicate a reasonably well oxidized effluent is entering and mixing with groundwater. Near the toe of the mound, E. coli measurements were less than ten colonies per 100 mls. These data indicate that both nutrients and pathogens are being eliminated by the disposal system and underlying soils. Additional detailed discussion on the performance of the system is discussed later in this report.

Site No. 54

1. Site Location and Description

Site No. 54 is located in Middlebury, Vermont. The system is classified as a mound/in-ground system. According to the available design plans, the hybrid system was created by stripping of topsoil to make a level bed area and utilizing mound sand/coarse sandy loam as fill to raise the dispersal trench 1'-2' above the new grade. Systems in this design class were generally constructed with the up-hill side of the dispersal trench at or slightly below original grade with the downhill edge of the dispersal bed approximately 1'-1.5' above original grade. Unspecified "sand" was placed beneath the dispersal trenches. SCS mapping indicates that underlying soils are Farmington stony loam soils. The borings reported friable silt clay with a blocky texture. Mottling was observed at 3" below ground surface. The system is installed on an 18% slope. The surficial geology map classifies the parent material as lake bottom silt. The bedrock is mapped as Bascom limestone. The water supply for the residence is an unmetered drilled bedrock water source.

2. Disposal System Design and Use

Site No. 54's wastewater disposal system features a 1,000 gallon concrete septic tank which flows by gravity to an in-ground/mound type system. The basal area is estimated to be approximately 1,200 sq. ft., which results in a basal loading rate of 0.06 g/d/sq. ft. We estimate the disposal trench loading rate is 0.17 g/d/sq. ft. We estimate the disposal area length to be 45'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 9 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 2 g/d/lin. ft. The site has three bedrooms with three residents and has been in operation for 18 years. A washing machine, dishwasher, and garbage disposal are also connected to the system. There is no utility sink or water softener. Observations of the system's performance through the years have not shown any surfacing, ponding, or noxious septic odors.

3. Groundwater Level and Wastewater Loading

Groundwater conditions in and adjoining the system were established through the installation and observation of three monitoring wells. The wells were monitored on five occasions between May 11 and June 11. Additionally, continuous water level recording of the system was provided from MW-1 from May 24 to June 4. Both the manual measurements and continuous monitoring show that there was no water to depth for the period of study. Using MW-2 as the typical monitoring location for the site, groundwater remained greater than 4.25' below ground surface. These observations are typical for an upland site with a significant side slope.

During the study, the disposal system loaded the site an average rate of 72 gallons per day, with the maximum observed rate of 115 gallons on one day. Weekly averages were slightly in excess of 500 gallons.

The combination of rainfall, snowmelt, and system loading did not result in any measurable groundwater closer than 3.33' below ground surface. Because this is a combined mound/in-ground type system, the distance from the disposal bed to groundwater is substantial and likely to be greater than 3'. Based on the significant separation distance, we believe that treatment objectives would be satisfied. As there was no groundwater through the period of study, no groundwater samples were acquired.

Site No. 55

1. Site Location and Description

Site No. 55 is located in Middlebury, Vermont, and is a gravity inground/mound type disposal system. The system was installed on Farmington soils. The soil borings reported silt loam texture with a friable consistency and granular structure. On-site measurements indicate the disposal area is situated on a 16% slope. The four test holes we advanced indicate mottles are within 3" of the ground surface. Notably, MW-3 located just downslope from the disposal area indicates bedrock at 21".

The surficial geology map classifies the parent material as lake bottom silts and clays. The bedrock is mapped as Bascom formation. The potable water supply for the property is provided by a drilled well that is not metered. There is a water softener, but the discharge point for the backwash was not known.

2, Disposal System Design and Use

Site No. 55's waste disposal system is classified as a mound system. A 1,000 gallon concrete septic tank flows by gravity to the elevated mound type disposal bed. The basal area of the site is estimated to be 900 sq. ft. for a typical daily application rate of 0.06 g/d/sq. ft. The layout of the system indicates a dispersal area loading rate of 0.12 g/d/sq. ft. We estimate the disposal area length to be 40'. Utilizing the residence bedroom count and

current Rules-based wastewater flow an LLR of 11 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 1 g/d/lin. ft. A professional was engaged to provide design services. The system has been in service for over 20 years. Through that period of time the two to three occupants of the three-bedroom home have not observed any evidence of failure, including surfacing, ponding, or septic odors.

Based upon the system design and significant depth to the water table, it is likely that unsaturated soil thickness beneath the disposal trench meet current Rule design standards. Due to the fact that the site was dry throughout the monitoring period, no water samples were taken.

3. Groundwater Level and Wastewater Loading

Groundwater conditions were established by monitoring groundwater levels in four monitoring wells installed within and downslope from the system. Manual measurements of the water level were made between May 11 and June 11. Depths to the bottom of the wells ranged from 1.65' in MW-3 to 4' in MW-1. No groundwater was observed during any of the five site visits made during the study. In addition to the manual measurements, an automatic water level recorder was installed in the deepest well. This took continuous measurements between May 11 and 24. At no time during the recording period did rainfall or loading from the system create a measurable water surface. Conditions on this site would be characterized as dry.

While groundwater measurements were being taken, the disposal system was loading the site at an average rate of 55 gallons per day. The peak one-day discharge rate was estimated to be 101 gallons per day. The average weekly flow to the system was 388 gallons per week. Wastewater was generated from two occupants in a three-bedroom house. The residents utilize a washing machine, dishwasher, and garbage disposal.

The combination of rainfall, snowmelt, and system loading did not create a measurable water level surface during the period of study. An examination of the individual boring logs (see MW-1 to MW-4 attached) indicates nearly saturated conditions in MW-2 at a depth of 12"+ below ground surface. This observation is related to the native soils with a high moisture content, short of fully saturated conditions. There is no notation of septic odors in the soil descriptions.

Site No. 56

1. Site Location and Description

Site No. 56 is located in Middlebury, Vermont. The plan view and cross section of the system indicates that this is an in ground mound system. It appears that the ground surface was prepared so that a portion of the system resides on a flat bottom with a raised bed of sand. The disposal system is installed on Farmington soils. A silt loam texture soil with a friable consistency and a granular structure is described in the boring logs. The disposal area is situated on a 20% slope. Mottling was observed at 3" below ground surface. Four test borings were advanced on site at depths ranging from 26"- 46". Approximate locations of the test borings are shown on the engineering plans (see Companion Binder). Bedrock was identified at a depth as shallow as 46" below ground surface.

The surficial geology map classifies the parent material as lake bottom silts and clay. The bedrock is mapped as Bascom formation. Bedrock was encountered in boring Nos. 1 and 2. The wastewater system appears to be situated in a typical upland till soil on a steep slope.

The potable water supply for the property is provided by a drilled well that is not metered. There is a water softener. The backwash is discharged to the septic system.

2. Disposal System Design and Use

The system has a 1,000 gallon concrete septic tank that flows by gravity to the raised bed system. The available engineering data indicates that there are 2,280 sq. ft. of basal absorption area. The average basal application rate is 0.05 g/d/sq. ft. The 500 sq. ft. of dispersal trenches are loaded at 0.25 g/d/sq. ft. We estimate the disposal area length to be 50'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 10 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 2 g/d/lin. ft. A design professional was engaged to assist in the location and layout of the system. Occasional slight odors are reported by the residents.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the spring high water period were monitored through a series of four wells installed within and downslope of the waste disposal system. The borings were advanced to depths ranging from 2.17' to 3.67'. Three of the four wells were dry to depth from May 11 to June 11. MW-3 displayed groundwater levels from 1.61'-2.41' until May 24, after which it was dry. A water level recorder was installed in MW-1 on May 24 and collected data until June 4, but no groundwater was detected in the well.

During the field study, the disposal system was loading an average of 118 gallons per day. The maximum estimated one-day loading rate was 171 gallons. Weekly averages were 825 gallons per week. Interviews with the homeowners reveal that there are two occupants in the four-bedroom home. A washing machine, dishwasher, and garbage disposal discharge to the disposal system. There is a water softener to condition the potable supply, the backwash of which is also directed to the septic system.

The combination of rainfall, system loading and subsurface groundwater runoff created saturated conditions in only one well for a portion of the study. The maximum elevation to which the groundwater rose was 1.61' below ground surface. Given the raised bed design

of the system, it is likely that an unsaturated zone was maintained below the disposal bed to allow effluent renovation throughout the study period. No groundwater sample was acquired from the system for analysis.

Site No. 57

1. Site Location and Description

Site No. 57 is located in Bridport, Vermont. The property is serviced by an in ground disposal system. The in ground system is situated in SCS mapped Vergennes clay soils. The soil borings report silt loams with a friable consistency and blocky structure. The system is situated on a 7% slope. During the installation of monitoring points, mottling was identified at 3" below ground surface.

The surficial geology map classifies the parent material of this site as lake bottom sediment. The bedrock is mapped as Stony Point formation. The potable water supply for the residence is from a municipal service and metering data is available.

2. Disposal System Design and Use

Site No. 57's wastewater disposal system is comprised of a 1,000 gallon concrete septic tank which flows by gravity to a subsurface disposal system. Present owners have occupied the property for 13 years, but little is known of the actual engineering configuration of the system. To the best of our knowledge, no design professional was involved in the site selection and layout of the treatment system. It is assumed from field observations that the leachfield is 420 sq. ft. in size. This leads to an effluent loading rate of 0.49 g/d/sq. ft. We estimate the disposal area length to be 52'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 8 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 4 g/d/lin. ft.

Homeowners have not reported any ponding, surfacing, or noxious septic odors outside the facility, although a septic tank backup into the house has occurred.

3. Groundwater Level and Wastewater Loading

Variations in the phreatic surface during the monitoring period were established by a series of monitoring wells installed within and downslope from the disposal system. Subsurface water surface levels were manually tested on five occasions between May 11 and June 11. The three wells on the property showed water level elevations consistently between 0.70' and 2.20' below ground surface. On May 16 an automatic water level recorder was set in MW-1 and collected data continuously through May 31. The water surface ranged from 1.5' to 2.0' below ground surface. Subtle variations in the shape of the hydrograph are likely associated with loading from the waste disposal system. Larger variations are likely due to climactic inputs.

While the system was being monitored, loading from the waste disposal system averaged 205 gallons per day. The maximum daily loading was 210 gallons on one day. Average weekly loading was 1,434 gallons. For this study of 27 systems, this site received the largest volume of wastewater on a daily or average weekly basis.

Presently, four people live at the three bedroom residence. A washing machine and dishwasher are utilized. There is no garbage disposal, utility sink, or water softener.

The combination of rainfall, snowmelt, and system loading kept groundwater consistently from 1' to 2' below ground surface. Because this is an in ground system, it is unlikely that an unsaturated zone (separation distance) was maintained below the seepage bed.

Water quality samples were acquired from MW-1 and MW-3 on May 31. The distribution of nitrogen species confirm that the leaching bed is flooded, showing a predominance of TKN and an absence of unoxidized nitrogen species (Appendix 2, Page 11). Measurable E. coli were also identified in MW-1 and MW-3, well in excess of the Class B Water Quality Standards. Additional discussion of the water quality results are presented later in the report.

Site No. 74

1. Site Location and Description

Site No. 74 is located in Addison, Vermont. The waste disposal system serving the property is a mound. The SCS maps soils as Vergennes clay. Soil tests on the property indicate a silty clay texture with firm consistency and blocky structure. The mound is situated on a 15% slope. Depth to mottling was identified at approximately 3" below ground surface.

The surficial geology map classifies the parent material as lake bottom silt and clay. The bedrock is mapped as Stony Point formation. The water supply for the residence is provided by the town but is not metered.

2. Disposal System Design and Use

Site No. 74's system is comprised of a 1,000 gallon concrete tank which flows to a 1,000 gallon pump station. Wastewater is pumped from the pump station to the waste disposal system. The system was installed in conformance with the recommendations of the design professional. The system has been in service for 5 to 10 years. The owner has not reported any wet or ponded areas or noxious septic odors. There have been no observed manifestations of failure. The available plans indicate that the basal area for the mound is 2,415 sq. ft. This results in a very low application rate of 0.01 g/d/sq. ft. The dispersal area (420 sq. ft.) has an average loading rate of 0.07 g/d/sq. ft. (or less). We estimate the disposal area length to be 105'. Utilizing the residence bedroom count and current Rules-

based wastewater flow an LLR of 4 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 0.3 g/d/lin. ft.

3. Groundwater Level and Wastewater Loading

Groundwater conditions at the time of the study were recorded in three monitoring wells installed within and downslope of the mound disposal system. Groundwater depths for this property are compiled in the Companion Binder. Manual measurements were taken on five occasions between May 10 and June 11. A water level datalogger was installed in MW-1 and ran continuously from May 10 to 24. On May 10 and 16 groundwater was identified from approximately 2.37' to 3.72' below ground surface. After this point, all monitoring wells were dry. The water level recording device, installed at a depth of approximately 4.5' below ground surface, did not record any groundwater in MW-1 through the period.

At the time of the study there was one occupant in the three-bedroom home. The average daily water use was 29 gallons per day, with a peak of 50 gallons per day being estimated. The average weekly loading to the wastewater system was 200 gallons.

When water table was observed, the combination of rainfall, snowmelt, and system loading maintained groundwater levels from 2.5' to 3.5' below ground surface. This would have placed the seasonal high water table well below the elevation of the mound bed. It is likely that this system is operating in accordance with the Rules design objectives. No water quality samples were collected from this site.

Site No. 75

1. Site Location and Description

Site No. 75 is located in Weybridge, Vermont. The waste disposal system serving the property is a mound type, situated on SCS mapped Swanton fine sandy loam. Soil boring data shows silt loams with a firm consistency and blocky structure. The system is on a 15% slope. Mottling was noted at 4" below ground surface.

The surficial geology map classifies the parent material as lake bottom deposits. The bedrock is mapped as Winooski dolomite. The water supply for the residence is provided by a drilled well that is not metered.

2. Disposal System Design and Use

Site No. 75's system has a 1,000 gallon concrete septic tank which flows by gravity to a 1,000 gallon pump station. Wastewater is pressurized and pumped to a mound-type disposal system. The basal area of the mound is 2,448 sq. ft. This results in an average application rate of 0.06 g/d/sq. ft. of basal area. The dispersal trenches have a loading rate of 0.39 g/d/sq. ft. We estimate the disposal area length to be 102'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 4 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 2 g/d/lin. ft.

The residents have owned this property for five years. They have not identified any ponding, backups, surfacing, or noxious septic odors. A washing machine and dishwasher are used by the four residents of this three-bedroom house and are discharged to the disposal system.

3. Groundwater Level and Wastewater Loading

Groundwater elevations during the study were established in the four monitoring wells installed within and downslope of the waste disposal system. Groundwater depths ranged from 1.37' to greater than 2.25' below ground surface. Manual measurements were taken on five occasions between May 10 and June 11. On May 2 a datalogging water level monitoring device was installed in MW-1. Initially, groundwater was present approximately 2.5' below ground surface. Through the month of May water levels fell to approximately 4' below ground surface. Variations in the hydrograph (see Companion Binder) are the result of on-site loading and incidental precipitation events. During the groundwater monitoring period daily estimated wastewater application rates vary from an average of 158 to a maximum of 201 gallons per day. The average weekly loading to the wastewater system was 1,105 gallons. These flows were generated by four residents in a three-bedroom house.

The combination of rainfall, snowmelt, and system loading raised groundwater to a maximum observed level of 1.37' below ground surface in MW-2. Because this is a mound-type disposal system, it is likely that a significant unsaturated zone remained below the disposal bed, providing levels of treatment contemplated by the engineered design and Rules.

Site No. 77

1. Site Location and Description

Site No. 77 is located in Cornwall, Vermont. The wastewater disposal system serving the property is a replacement mound situated on SCS mapped Vergennes clay soils. Soil boring data collected during monitoring well installation confirms the clay soil type with hard consistency and blocky structure. The wastewater disposal system resides on a 15% slope with mottling identified at 5" below ground surface. The geology maps classify the parent

material as till. The bedrock is mapped as Beldens dolomite. Water is supplied by a drilled bedrock well that is not metered.

2. Disposal System Design and Use

Site No. 77's wastewater disposal system is comprised of a 1,000 gallon concrete septic tank that drains via gravity to a 1,000 gallon concrete pump station. The effluent is then pressurized and distributed to a mound disposal system. The dispersal trenches within the mound have a combined area of 440 sq. ft. This results in an average wastewater application rate of 0.12 g/d/sq. ft. The basal area of the mound is 2,167 sq, ft. resulting in an average loading rate of 0.02 g/d/sq. ft. We estimate the disposal area length to be 110'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 4 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 0.5 g/d/lin. ft.

The two-year-old system has been utilized primarily by two residents in the three-bedroom home. A washing machine and water softener are in place at the residence and they discharge to the wastewater disposal system. The water softener backwash is discharged to the septic tank. The residents have identified some intermittent odors and occasional backup of effluent due to drainage line pitch and filter clogging.

3. Groundwater Level and Wastewater Loading

Groundwater elevations during the study were determined utilizing four monitoring wells installed within and downslope of the wastewater disposal system. Groundwater was never measured in any of the monitoring wells and was at least 3.3' below grade. Within the mound system groundwater was never closer than 4.9' of the surface of the mound. Manual elevation measurements were collected on five occasions from mid-May through mid-June. A water level datalogger was placed in MW-1 from May 3 to 24. At no time was groundwater measured in this well. During the groundwater monitoring period, estimated daily wastewater application rates varied from 54 to 75 gallons per day. Average weekly

water use was approximately 377 gallons. These loads are currently generated by two individuals occupying the three-bedroom home.

Groundwater discharge and wastewater disposal system loading failed to raise the groundwater to within 3.3' below ground surface. This best fix, mound type disposal system maintained a significant unsaturated zone below the disposal trenches, likely providing the thickness of unsaturated soil anticipated by the Rules. As no groundwater was measured on site, no water quality data was collected.

Site No. 79

1. Site Location and Description

Site No. 79 is located in Cornwall, Vermont. The wastewater disposal system is placed on Nellis stony loam soils and is a mound-type system. The soil boring logs indicate the transmitting soils beneath the mound consist of a friable, granular loam. Mottling was observed at 9" below ground surface and slope was 14%. The surficial geologic map indicates the site is underlain by lake bottom silts and clays. Bedrock is mapped as the Orwell limestone. The residence is served by a drilled bedrock water supply well that is not metered.

2. Disposal System Design and Use

The wastewater disposal system is comprised of a 1,000 concrete septic tank flowing via gravity to a 1,000 gallon pump station. The wastewater is then distributed under pressure to a mound-type disposal system. The dispersal area within the mound is 500 sq. ft. and has an average loading rate of 0.35 g/d/sq. ft. The basal area beneath the mound is calculated at 1,400 sq. ft., resulting in an average loading rate of 0.13 g/d/sq. ft. We estimate the disposal area length to be 50'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 10 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 4 g/d/lin. ft.

The four-bedroom residence has been occupied for five years by four people. A washing machine and dishwasher are present and connected to the system. The owners have not identified any ponding, surfacing, or septic odors. Some backup of the wastewater did occur; however, this is attributed to an improperly pitched pipe beneath the residence. The system was designed by a licensed designer and is a “best fix” replacement system.

3. Groundwater Level and Wastewater Loading

Groundwater elevations were determined beneath the site utilizing four monitoring wells place within and downslope of the wastewater system. The general locations of the monitoring wells with respect to the system design are shown in the Site 79 section of the Companion Binder. Manual groundwater measurements were obtained on five occasions between May 11 and June 11. A datalogger was placed within MW-1 and collected data continuously from May 3 to 24. At no time was groundwater measured in any of the monitoring wells. Therefore, groundwater was continually greater than 3’ below native ground surface and 3.25’ below the top of the mound. During the groundwater monitoring period, wastewater was applied to the disposal system at an average of 177 gallons per day, with a maximum one-day usage of 235 gallons. The average weekly wastewater application was 1,240 gallons.

Natural recharge and wastewater system loading failed to raise groundwater to within the maximum depth of observation of 3.85’ below ground surface. It is likely that a significant unsaturated zone remains beneath the disposal bed despite the presence of mottling within 1’ of grade. The significant unsaturated zone likely provides the effluent renovation anticipated by the Rules. Due to the lack of groundwater, no water quality samples were collected.

Site No. 80

1. Site Location and Description

This site is in Whiting, Vermont. The wastewater disposal system is a mound placed on SCS mapped Vergennes clay soils. Soil boring data collected indicates native soils beneath and adjacent to the disposal system as silt with a friable consistency and blocky structure. Evidence of mottling exists at 10" below ground surface, which is sloped at approximately 14%.

The surficial geology map classifies the parent material as lake bottom silts underlain by Danby and Potsdam quartzite bedrock. The residence is supplied with potable water via a drilled bedrock well which is not metered.

2. Disposal System Design and Use

The wastewater disposal system for Site No. 80 was designed by a licensed professional and consists of a 1,000 gallon concrete septic tank which flows via gravity to a 1,000 gallon pump station. The wastewater is dispersed into trenches equaling 494 sq. ft. in area. An average dispersal area loading rate of 0.16 gallons per square foot per day has been estimated. The basal area for the system is 3,420 sq. ft. and is loaded at an average estimated rate of 0.02 g/d/sq. ft. We estimate the disposal area length to be 130'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 3 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 1 g/d/lin. ft. This system has been utilized for two years by the three residents of the three-bedroom home. A washing machine, dishwasher, and water softener are present. All fixtures including the water softener backwash discharge to the septic tank. The curtain drain surrounding the mound was observed, but no active flow was seen. Some ponding of waters exiting the drainage area were noted. No ponding, backup, or surfacing of effluent has been observed.

3. Groundwater Level and Wastewater Loading

Groundwater elevations during the study were measured utilizing three monitoring wells installed within and immediately downgradient of the mound system. The general locations of the monitoring wells are shown on the map in the Companion Binder. Manual measurements of groundwater elevations were collected on five occasions from May 11 to June 11. A continuous datalogger collected water level information from June 4-12. At no time during groundwater monitoring was a phreatic surface measured. Groundwater remained at least 3.67' below grade at the toe of the mound and greater than 4.40' below grade within the mound. Wastewater application rates during the monitoring period averaged an estimated 78 gallons per day with a maximum one-day usage of 140 gallons. Average weekly water use was 545 gallons. These water flows were generated by the three residents within the three-bedroom home.

Natural recharge and wastewater system loading failed to raise the groundwater elevations to the maximum observed depth of 4.40' below grade. It is likely that the significant unsaturated zone is providing effluent treatment to the level contemplated by the Rules. No. water quality data was collected at this site.

Site No. 82

1. Site Location and Description

Site No. 82 is located in Weybridge, Vermont, and is served by a mound-type disposal system. SCS mapping indicates the site is situated on Canandaigua silt loam soil. The soil borings report silty clay with firm consistency and blocky structure. In-field assessment of soil conditions indicate mottles are often identified within 6" of the ground surface. The waste disposal system is situated on a 15% slope.

The surficial geology map classifies the parent material as lake bottom silt and clay and bedrock as Winooski dolomite. The water supply for the residence is provided by a drilled well that is not metered. No water softener is used to precondition the bedrock well water. The residence has a washing machine and is currently occupied by three individuals.

2. Disposal System Design and Use

Site No. 82 is served by a 1,000 gallon concrete septic tank with a tank filter. The septic tank outlet flows by gravity to a 1,000 gallon pump station, which delivers effluent to the mound system. Based on the system design, the basal area for the site is 2,184 sq. ft., which when combined with average estimated water usage rates, yields 0.05 g/d/sq. ft. of basal area. The dispersal trenches have a loading rate of 0.23 g/d/sq. ft. We estimate the disposal area length to be 50'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 8 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 2 g/d/lin. ft. The system was designed by a professional designer.

3. Groundwater Level and Wastewater Loading

Groundwater conditions during the monitoring period were established in three monitoring wells installed within and downslope of the toe of the mound disposal system. Manual groundwater measurements were taken on five occasions between May 10 and June 11. Depths to groundwater ranged from approximately 1.45' to greater than 4.5' below ground surface. On May 2 a water level datalogger was installed in MW-1 and continuously collected data until May 16. When initially installed, the groundwater was observed to be 2' below ground surface by the datalogger. There was a continuous groundwater level decline through the period of study. Normal and expected variations in the shape of the hydrograph occur as a consequence of wastewater loading and intermittent precipitation events. The hydrograph is displayed in the Companion Binder.

At the time of the study there were three occupants in the three-bedroom house. The average estimated daily water use was 106 gallons per day. The average weekly loading to the wastewater system was 742 gallons.

The combination of rainfall, snowmelt, and system loading elevated groundwater levels to within 1.5' below ground surface for a sustained period of time. In view of the mound system design and the depth to groundwater, a separation distance of nearly two feet existed between the bottom of the disposal trench and the water table through the study period.

Site No. 83

1. Site Location and Description

Site No. 83 is located in Monkton, Vermont. The site is served by a mound type wastewater disposal system situated on Raynham silt loam soil. In the boring logs the soils are described as silt loam with firm consistency and granular structure. Field measurements indicate the system is located on an 18% slope with depth to mottling identified at 21" below ground surface. This is the maximum depth to mottling identified at any of the 27 study sites.

The surficial geology map classifies the parent material as lake bottom silt and clay. Bedrock is described as the Dunham dolomite. The water supply for the residence is provided by a drilled well that is metered. There is a water softener on the system, which backwashes into the septic tank. The residents did not provide a water use survey.

2. Disposal System Design and Use

Site No. 83 is served by mound-type disposal system with a 1,000 gallon concrete tank. After clarification of the effluent, wastewater is delivered to a 1,000 gallon pump station which then delivers wastewater to a leachfield by a force main. The basal area for the disposal system is 2,480 sq. ft. The dispersal area is estimated to be 492 sq. ft. No water usage data was provided. We estimate the disposal area length to be 80'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 5 g/d/lin. ft. was calculated.

3. Groundwater Level and Wastewater Loading

Groundwater conditions adjacent to the wastewater disposal system were investigated by the installation of three monitoring wells at the approximate locations shown on the attachment. Manual measurements of groundwater depths were taken on five occasions between May 10 and June 11. The manual measurement data indicates that groundwater levels varied from a minimum of 0.94' to a maximum of greater than 4.17' below ground surface. A continuous record of water level measurements was established by installing a datalogging water level recorder in MW-1 from May 16 to 31. Continuous water level recordings show that the site responds to individual daily loadings and precipitation events. The data indicates that groundwater generally stayed more than 3.6' below ground surface during the two-week monitoring period. At the time of the study there were four occupants in the three-bedroom home. A washing machine, dishwasher, and water softener also discharge to the wastewater disposal system.

Site No 84

1. Site Location and Description

Site No. 84 is located in Weybridge, Vermont, and is served by a mound-type waste disposal system. The SCS identifies the waste disposal area as having Vergennes clay soils. Soil boring logs indicate a sandy loam with friable consistency and granular structure in the transmission zone. The area of the mound is on a 12% slope and mottles were identified at a depth of 6" below ground surface.

The surficial geology map classifies the parent material as lake bottom silt and clay. The bedrock is mapped as Morses Line formation (Omi). The water supply for the residence is provided by a drilled well that is not metered.

2. Disposal System Design and Use

Site No. 84's wastewater disposal system is comprised of a 1,000 gallon concrete tank and 1,000 gallon pump station. Effluent is dispersed under pressure to dispersal trenches that are estimated to be 500 sq. ft. in size. An average dispersal trench loading rate of 0.06 per square foot has been estimated. The estimated basal area of the mound is 1,800 sq. ft. and the average loading rate is 0.02 g/d/sq. ft. We estimate the disposal area length to be 75'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 1 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 0.4 g/d/lin. ft. There is a washing machine, dishwasher, utility sink, and water softener in the residence. These discharge to the disposal system. The discharge point of the water softener backwash is unknown. At the time of the study there were three employees using the building. The average daily water use was 30 gallons per day, with a peak of 47 gallons in one day being estimated. The average weekly loading to the wastewater system was 207 gallons. A professional designer was utilized to design the system. The system has been in service for approximately one year. No evidence of ponding, surfacing, or septic odors have been identified.

3. Groundwater Level and Wastewater Loading

Groundwater conditions observed during the monitoring period were recorded in the four monitoring wells installed at the approximate locations shown in the Companion Binder. The wells were installed within the absorption bed, in the mound fill material, and downslope of the mound disposal system. Logs of the wells are provided in the attachment. Groundwater depths were measured on six occasions between April 23 and June 11. No groundwater was identified in any of the wells at depths from 3.16' to 4.75' below ground surface. A datalogging level recorder was installed in MW-1 on April 19 and ran continuously until May 10. No groundwater was identified to a depth of approximately 4.75' below ground surface.

The combination of rainfall, snowmelt, and system loading was not sufficient to elevate groundwater to within 3.16' of the ground surface. In view of the fact that the waste disposal system is a mound disposal system, a significant unsaturated zone was maintained under the disposal bed. Therefore, it is likely that this system is operating in accordance with the design objectives.

Site No. 85

1. Site Location and Description

Site No. 85 is located in Ferrisburgh, Vermont, and is served by an in-ground wastewater disposal system. The system area is located on soils mapped as Berkshire stony loam. Soil boring data indicates a silt loam texture, friable consistency, and granular structure in the transmitting horizon below the system. Field measurements indicate the system is installed on an 11% slope. Depth to mottling was identified at approximately 4" below ground surface.

The surficial geology map classifies the parent material as glacial till. The bedrock is mapped as Middlebury and Chazy limestone. The water supply for the residence is provided by a drilled well that is not metered. There is no water softener for pre-treatment of potable water. The residents did not provide a water use survey response.

2. Disposal System Design and Use

Site No. 85's wastewater disposal system is comprised of a 1,000 gallon concrete septic tank which discharges via gravity to an in-ground wastewater disposal system. Infield measurements indicate that the disposal area is approximately 1,770 sq. ft. We estimate the disposal area length to be 125'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 3 g/d/lin. ft. was calculated. No information regarding water usage was supplied by the property owner. The home has been occupied by four residents for approximately 18 years, utilizing three bedrooms. No wet or ponded areas or noxious septic odors were observed during our site visits. A washing machine and utility sink are in use at the residence. These wastes are conveyed to the disposal system.

3. Groundwater Level and Wastewater Loading

Groundwater conditions at the time of the study were recorded in three monitoring wells. Manual measurements were taken on four occasions between May 11 and June 11. Periodic measurements indicate groundwater is as shallow as 0.42' and deeper than 3.75' below ground surface. A datalogger was installed in MW-1 in late May. Upon removal, the datalogger file was found to be corrupted and could not be reclaimed.

Our interview with the owners of the property indicates that there are four residents in the three-bedroom home using a washing machine and utility sink.

The combination of rainfall, snowmelt, and system loading produced a maximum groundwater height of 0.42' below ground surface in MW-3.

Water quality samples were collected from MW-1 and MW-3 on June 7. The results indicate that the waste disposal system is very effective in converting and removing both phosphorous and nitrogen. MW-1, which is situated within the waste disposal system, had a total nitrogen content of approximately 45 mg/l. After passing through the disposal area to the toe of the system, total nitrogen concentrations were reduced to approximately 3 mg/l. Similar substantial reductions were seen in total phosphorous and total dissolved phosphorous concentrations. Additional commentary on water quality results is presented later in this report.

Site No. 90

1. Site Location and Description

Site No. 90 is located in Waltham, Vermont. The waste disposal system serving the property is a mound in soil mapped as Vergennes clay. The soil borings indicate a hard consistency and blocky subsurface structure in the clay. The area of the mound is on a 14% slope. Mottling is noted within the upper 10" of the soil profile.

The surficial geology map classifies the parent material as lake bottom silt and clay. The bedrock is mapped as Bascom limestone. The water supply for the residence is provided by a drilled well that is metered. There is no pre-treatment with a water softener.

2. Disposal System Design and Use

Site No. 90's system is comprised of a 1,000 gallon concrete tank from which effluent flows by gravity to a 1,000 gallon pump station, which delivers treated wastewater to the mound system via a two-inch force main. The system was designed by a certified designer. In addition to black water sources, a washing machine and dishwasher also discharged to the system. There is no garbage disposal or utility sink. The best available data for this site indicates the disposal system has a basal absorption area of 2,660 sq. ft. Using estimated water usage rates, this equates to a basal area application rate of 0.04 g/d/sq. ft. The

dispersal trench loading rate is 0.27 g/d/sq. ft. We estimate the disposal area length to be 140'. Utilizing the residence bedroom count and current Rules-based wastewater flow an LLR of 3 g/d/lin. ft. was calculated. However, the LLR based on water survey estimated use during this study is calculated to be 1 g/d/lin. ft.

3. Groundwater Level and Wastewater Loading

Groundwater conditions at the time of the study were recorded in three monitoring wells installed within and downslope of the mound disposal system. Manual measurements were taken on five occasions between May 11 and June 11. Groundwater levels were greater than 2.44' below ground surface on all occasions that the system was monitored. On May 11 a datalogging water level recorder was installed in MW-1and operated until June 2. Over that period of time, groundwater remained greater than 2.5' below ground surface. Groundwater fluctuations up to 1.5' in an individual week were recorded . As well, daily fluctuations resulting from loading to the system can be observed as small deviations in the hydrographs. Generally, these fluctuations range from 0.2' to 0.3'. During the monitoring period, the site experienced an average loading of 114 gallons per day, with peak discharge estimated at 131 gallons one day. The average weekly loading to the wastewater system was 800 gallons. Interviews with the two residents indicated that they have lived in the three-bedroom home for four years.

The combination of rainfall, snowmelt, and system loading raised groundwater to within approximately 2.44' below ground surface (see MW-2). Considering the use of a mound-type system and the separation to the water table, it is likely that this system is operating in accordance with the design objectives. No water quality samples were collected from this site.

4.0 INDUCED GROUNDWATER MOUNDING CALCULATIONS

Induced groundwater mounding (IGM) was calculated for the 13 sites which had manually measured groundwater levels in MW-1 and at least one of the downgradient wells MW-2 and MW-3 on one or more occasions. The IGM was calculated based on the elevation of groundwater relative to original ground surface. The groundwater elevation relative to original grade data generated from all study sites with sufficient groundwater presence are summarized in Appendix 2 page12. A positive relative groundwater elevation indicates the groundwater surface is present above the original grade. A negative relative groundwater elevation indicates the groundwater surface is located below original grade.

The data indicate that groundwater was manually measured above the original ground surface on one occasion only, in MW-1 only, at sites 43, 52, 82, and 85. Groundwater was measured 1.2 feet above original grade at site 43 on April 23, 2007. Groundwater elevation declined to 0.8 feet below original grade by May 11, 2007. At sites 52, 82 and 85, groundwater rose to 0.57, 0.10 and 0.30 feet above original grade respectively. Many of the sites showed groundwater elevations beneath the disposal field and downgradient rising to within six inches (0.5 feet) of original grade for at least one monitoring event.

Next the presence of an IGM was determined. For the purpose of this study, it was assumed that if groundwater elevation was unaffected by effluent disposal, groundwater elevations in MW-1, MW-2 and MW-3 would be the same relative to the original ground surface (ie mimicking original ground surface slope) (see diagram as Appendix 2 page 13). If an IGM existed, the groundwater elevation in MW-1 (directly below the disposal trench/bed) would be higher relative to the average groundwater elevations in MW-2 and MW-3 (at the downgradient edge of the disposal field). The IGM for each monitoring event is calculated and summarized on Appendix 2 page 14. The average IGM for each site is also presented on the table.

IGM calculations for the in-ground wastewater disposal systems at Sites 7, 40, and 57 indicate both higher and lower relative groundwater elevations in the disposal area as compared to downgraident.. The inconsistency of the potential IGM presence makes it difficult to reach any conclusions regarding these systems impact on the groundwater surface.

Each of the mound system sites show a fairly consistent presence of an IGM. IGM heights at the mound sites ranged from -0.31 (ie lower groundwater elevation beneath the disposal trench/bed) to +2.96 feet. The relative height of the IGM fluctuates at each site in direct correlation to the relative groundwater elevation. The higher the relative groundwater elevation beneath the disposal area (MW-1), the greater the measured IGM. In general, each sites IGM height was relatively stable throughout the monitoring period. As detailed above, the top of the IGM's were generally below the original ground surface during nearly all monitoring events, despite the presence of IGMs up to 2.96 feet in height.

A notable exception to the fairly stable IGM conditions at mound sites is site 52. The groundwater elevations relative to original ground surface measured in MW-1 on May 16, May 24, and June 1, 2007 were -0.75 feet , +0.57 and -0.68 feet respectively. These fluctuations resulted in the IGM fluctuating from -0.31 feet up to +1.18 feet, then back to –0.08 feet. During this same monitoring period the relative groundwater elevations downgradient of the disposal area in MW-2 and MW-3 remained essentially unchanged. These "flashy" groundwater elevation and IGM height fluctuations beneath the disposal area may be due to short circuiting of effluent through the mound sand.

A chart showing groundwater depth below grade at each of the sites exhibiting an IGM is included as Page 15 of Appendix 2. This chart clearly shows the region-wide trend in groundwater elevations throughout the monitoring period. Small short-term spikes in the groundwater elevation and individual sites can be seen as compared to the regional changes. These short-term spikes clearly show the temporary induced groundwater mound created during wastewater disposal system dosing. High usage periods are also evident by longer-term increases in the groundwater elevations (*i.e.,* Site No. 82, May 10 and 14).

Generally, these short-term spikes in IGM height are between 0.02 and 0.4 feet. The duration of the spike in IGM is less than eight hours in most cases.

The presence, height and fluctuation of the IGMs was compared to other identified site conditions including slope, soil structure, soil type, curtain drain presence, application rates and age. No discernable correlation between site conditions or wastewater system design and the presence, absence or size of a measured IGM exists. ,

It should be noted that the majority of the wastewater disposal systems with measurable IGM's were designed by licensed professionals. TReview of the system designs shows a significant degree of commonality with regard to the engineering parametsers utilized. We believe that this commonality and design is the primary reason why these wastewater disposal systems show minimal induced groundwater mounding into the mound sand and,m as discussed later, excellent effluent renovation capabilities. Common design parameters for each of the mound-type systems are as follows:

- Ground slope between 7-18%;
- Elevated "Mound" type disposal field;
- Pressure distribution to within mound;
- Linear loading rate using "Rules" based flow (150 gallons per bedroom per day) of less than 10 gallons per foot per day.
- Dispersal area size equal to approximately one gallon of effluent per square foot per day based on "Rules" flow rates;
- Basal area between 2,000-2,500 square feet;
- Curtain drain installed upgradient of the disposal field.

Utilization of these basic design parameters for the fine-grained silts and clays observed throughout the county has resulted in high-functioning disposal systems providing excellent effluent dispersal with the creation of minimal IGM's. Those IGM's that are formed dissipate quickly regardless of the underlying groundwater elevation fluctuations occurring regionally.

5.0 WATER QUALITY RESULTS and SYSTEM OPERATING STATUS AT TIME OF TESTING

Groundwater quality data was analyzed at selected sites which contained sufficient water in late May 2007. Both field and laboratory measurements were taken. These included temperature and conductivity, nitrate, nitrite, TKN, ammonia, total phosphorous, dissolved phosphorous, E. coli bacteria, and total coliform bacteria. These data help determine the oxidation status and, therefore, treatment potential of individual on-site systems. The removal of nutrients (nitrogen series and phosphorous) from the initial wastewater stream is well correlated with biologic treatment and neutralization/stabilization of septic tank effluent.

The groundwater monitoring results demonstrate that many of the 27 sites' monitoring wells were dry to depth for the entire monitoring period. For those sites where groundwater was available for testing, we selected a mix of in-ground and mound systems to evaluate the wastewater treatment effectiveness. Sites included in the groundwater analysis assessment are Nos. 40, 49, 52, 57, 75, 82, 83, and 85. It is important to note that the presence of groundwater at a relatively shallow depth (3' - 4' below ground surface) introduces a negative bias into the overall assessment of system analysis by the mere fact that the groundwater was present. We expect that sites which were dry to depth through the entire study would generally provide better treatment than that represented by the sites sampled during the study, so these samples provide a worst-case data set from which to evaluate system performance.

The in-ground systems are represented by site Nos. 40, 57, and 85. Mound systems are in place at site Nos. 52, 75, 82, and 83. Site No. 49 utilizes an Advantex pre-treatment system (textile filter), followed by a mound disposal area. None of the sites tested showed any evidence of physical failure, such as ponding or odors typical of untreated wastewater; and no system owners reported evidence of failures of their potable water sources related to their wastewater disposal systems. Therefore, all systems sampled were "not failing" by definition of the Rules during the sampling events.

Systems in Failure at Time of Study: For the 27 sites we analyzed, we consider two of them to be in failure. Our determination of "failure" was based on H&N or home owner observation of visible manifestation of wet spots, septic odors, or backup into the residence. A complete summary of these observations is contained in the Appendix 2, Pages 1-7. The systems which failed by the visual criteria included site No. 7, which had a septic odor, ponding, and wet areas, and No. 90, where ponded areas were observed.

Evaluation of Potential Biomat: To evaluate the potential mode of failure for systems in the study, we advanced a boring to the bottom of nearly all of disposal stone trenches or beds, to ascertain the depth of wastewater ponding and the thickness of the biomat. We anticipated that a biomat would be present in most systems, particularly the older ones. Biomat development is especially common in low-permeability, poorly drained soils. A surprise outcome of this study was that no biomat was in evidenced in any system, except at site No. 7. This site has a failing in-ground wastewater disposal area, and has been in operation for 17 years. The mode of failure appeared to be the consistent presence of groundwater within the dispersal trenches/beds during spring. As groundwater levels declined, the evidence of failure disappeared. With the exception of this single system, there was no effluent ponding measured in the dispersal stone of any systems in this study, and only weakly formed biomats at the stone/native soil or stone/mound sand interface were observed. The boring logs for the wells advanced through the dispersal areas (MW-4) consistently indicate that the interface between the dispersal stone and the receiving soil beneath the stone often has a much higher moisture content, no doubt owing to the significant permeability change in the development of a minor biomat, but there were no signs of ponded effluent in the disposal beds or trenches. The overriding conclusion that we reach from these observations is that the water survey estimated use and application rate is far below the design standard, resulting in favorable system performance even on sites with challenging soils or conditions

6.0 PHYSICAL PARAMETER TESTING OF GROUNDWATER QUALITY

Prior to obtaining laboratory samples, groundwater in the monitoring wells was measured for temperature and electrical conductivity (see Appendix 2, Page 14). Conductivity near the waste disposal beds (MW-1) ranged from 400 to 2,700 micromhos. We expect background groundwater conductivity to be 50 - 200 micromhos for these soil types and land uses. In our study, conductivity values measured in the monitor wells which which were located immediately downgradieint of the wastewater disposal areas (MW-2 and MW-3) were generally in the range of 800 - 1,000 micromhos.

The effects of dilution and dispersion on the dissolved constituent chemistry can be assessed by analyzing reductions in electrical conductivity with distance from the system. As an example, site No. 57's wastewater disposal system had a conductivity of 2,180 micromhos within the mound system (MW-1). The conductivity was reduced by nearly one-half as one moves from the absorption area to the toe of the mound and beyond. Statistics like this, while qualitative, suggest that a 50% reduction (*i.e.*, "treatment") in the concentrations of the nutrient series within a short distance downgradient of wastewater disposal systems is likely to occur simply from dilution and dispersion.

Groundwater temperatures proximal to the leaching bed for all sites varied from approximately 52 - 56°F for the measurement period that occurred between May 31 and June 7, 2007. These temperatures are somewhat elevated above expected ambient groundwater temperatures at this time of year, and are likely the result of a thermal surcharge from the wastewater. Wells distal to the dispersal areas (MW-2 and -3) typically had temperatures 4 - 6°F less than those in the leachfield area (MW-1). These distal-well values are typical of "average" groundwater temperatures measured in shallow native flow systems.

7.0 BIOLOGICAL RESULTS

Sampling of total coliform and E. coli bacteria was performed at seven of the sites. The data is summarized in the table included as Appendix 2, Page 14. The lab results are included in Appendix 4. The EPA On-Site Wastewater Treatment Systems Manual, and research performed in the 1970's and 1980's at the University of Wisconsin, indicate that pathogenic concentrations (including viruses) are reduced six to eight orders of magnitude after wastewater passes through one to two feet of unsaturated soil beneath an absorption bed. This typically results in indicator bacteria counts in groundwater directly beneath a dispersal system of less than 100 organisms per 100 milliliters (ml) of water. Review of the study data indicates that potential short-circuiting of septic tank effluent to the groundwater surface is occurring at several sites. Notably, site Nos. 57, 82, and 85 show elevated total coliform and E. coli concentrations downgradient of the disposal area (*i.e.*, MW-2 or MW-3). Site Nos. 57 and 85 are in-ground wastewater disposal systems which have minimal depths of unsaturated soils beneath them. Site No. 83 has an elevated level of total coliform bacteria, but no quantifiable presence of E. coli bacteria.

Generally, groundwater sampled from wells located within 10 feet downgradient of wastewater disposal trenches or beds showed significantly reduced levels of total coliform and E. coli when compared to the in-field groundwater samples. Most samples obtained from the downgradient wells (MW-2 and MW-3) report no quantifiable concentrations of E. coli bacteria, and total coliform bacteria concentrations less than 1,000 organisms/100 ml.

Comparison to Vermont Surface Water Quality Standards: An important metric for determining if reasonable treatment is occurring would be a comparison of groundwater results with the Vermont Surface Water Quality Standards (effective February 9, 2006), for water quality criteria for Class B waters. It is assumed that each of the wastewater disposal systems studied are likely to have an ultimate groundwater discharge zone into Class B surface waters. The current E. coli bacteria standard for this type of water is 77 organisms/100 ml. The very limited amount of bacteriological data collected during the study indicates that a significant reduction in bacteriologic contamination occurs through the

mound sand (generally to non-detected levels), with additional reductions typically to well below the Class B water quality standard within a few feet downgradient of wastewater disposal systems on challenging sites (again, to generally non-detected values.

8.0 GROUNDWATER CHEMISTRY

The literature for the chemistry of individual on-site septic tank influent and effluent is well known, so samples of septic tank supernant were not collected for this study. Utilizing data from the EPA On-Site Wastewater Treatment Systems Manual, we assumed that the septic tank waste stream would be anaerobic (excepting the Advantex system) prior to entering the wastewater disposal system, and that Total Kjeldall Nitrogen (TKN) and ammonia would be the dominant nitrogen species. We assumed that the Total Nitrogen concentration would be between 50 and 80 mg/l. Total phosphorous and total dissolved phosphorous concentrations in the effluent were assumed to be in the 10 - 20 mg/l range. Coliform bacteria concentrations of 10^5 t0 10^7 colonies per 100 ml were also assumed.

As described in the EPA Manual and other documents, typical treatment capacities of unsaturated soils beneath a properly functioning wastewater disposal system show a reduction of ammonia and TKN via oxidation. As these nitrogen species are oxidized (reduced), nitrate concentrations increase.

Data collected during our study indicate TKN, ammonia, and nitrite concentrations in the monitoring wells closest to the disposal systems (MW-1) range from 2 - 30 mg/l. Oxidized nitrate concentrations directly beneath the dispersal trenches were between non-detect levels (less than 0.2 mg/l) to a high of 34 mg/l. Generally, the concentration of unoxidized nitrogen species was higher in the groundwater immediately beneath in-ground disposal systems than beneath mound systems. This is best illustrated by comparing the nitrogen species concentrations in MW-1 at site Nos. 52 and 85. Site No. 52 disperses effluent via a mound system. The unoxidized nitrogen species concentrations in the groundwater collected immediately adjacent to the dispersal bed at No. 52 are approximately 2.4 mg/l. By contrast, site No. 85, which has an in-ground disposal system, shows an unoxidized

nitrogen species concentration immediately adjacent to the dispersal bed of approximately 45 mg/l. The oxidized nitrogen species concentration at site No. 52 (the mound) is approximately 5 mg/l, while site No. 85 (in-ground system) has a nitrate concentration of 0.5 mg/l. This shows the oxidative processes occurring in the sand fill of this mound-type disposal system. Further evaluation of the water quality data collected in downgradient wells (MW-2 or MW-3) at site Nos. 52 and 85 shows that nitrate reduction continues to occur downgradient of the disposal system.

Total dissolved phosphorous and total phosphorous concentrations are also reported on a table presented as Appendix 2, Page 14. Review of this data corroborates the biological and nutrient reduction levels discussed previously. Phosphorous concentration reductions of up to one order of magnitude are seen throughout the study area. Both mound and in-ground disposal systems show reductions of dissolved phosphorous to below the detection limit of .005 mg/l.

These two sites, which represent two different end points of the types of rural wastewater disposal system design seen in Vermont in the past, illustrate that within a very short distance from the toe of a mound, or the perimeter of an in-ground system, substantial treatment of nutrients has occurred irrespective of the oxidation status in the actual disposal area. Combining the positive outcome of the biological treatment described above, and the nutrient treatment observed, a general rule of thumb evolves. If there are no overt physical or olfactory manifestations of failure, it is likely that adequate and significant effluent treatment is occurring within a waste disposal system and the immediately surrounding soils. We think it would be important to test this hypothesis by collecting additional information from a subset of the wastewater disposal systems that have been evaluated in this study.

9.0 DISCUSSION, ANALYSIS AND FINDINGS

- Twenty-seven (27) wastewater disposal systems installed at sites which would not likely be allowed utilizing current Rules were examined to determine site characteristics key to the systems' proper treatment and operation. Two of the studied systems during the wetter portions of the study period were deemed as failing due to ponding of effluent at grade or persistent odors. One of the failing systems is an in-ground disposal system approximately 17 years old, and the other is a mound only 4 years old. Only the in-ground system was found to have a significant biomat, dark-to-black staining of the leachfield stone, and standing effluent in the leachfield. Surfacing of effluent was observed during the initial investigation of the failing in-ground system in mid-April 2007. However, by June 1, 2007, we no longer observed surfacing effluent or detected sewage odors, and groundwater levels in the monitoring wells at this system had declined to greater than 1.5' below grade.

  Despite the mid- to late-April snowstorms, many of the sites investigated consistently showed groundwater at depths greater than 1' below ground surface. In fact, many sites showed groundwater depths greater than 3' below ground surface throughout the entire monitoring period of this study. It is noted that "soil mottling" was observed at each of the sites within 9" of grade, and in most cases at less than 4" below grade. This is likely the result of dry to normal spring conditions.

- The consistent presence of induced groundwater mounds were measured at ten of the sites with mound type disposal systems. The height of the IGM at each site is directly correlated ot the relative groundwater elevation beneath the site. As groundwater elevations decline beneath the disposal system, the IGM height also declines. Nearly all of the measured IGM sat mound sites were relatively stable in height. One exception (site 52) showed evidence of effluent distribution short circuiting through the mound sand due to its severe fluctuations in IGM height and uncharacteristic groundwater quality results at the toe of the mound.

- During this study period, we found that the average water use per person per day was approximately 38.8 gallons, approximately 55% of the assumed individual water usage dictated in the Rules. We also observed that the occupancy of the single-family homes was much less than the "two individuals per bedroom" prescribed by the Rules. There is a total of 87 bedrooms at the 27 studied sites, which would necessitate the design of these wastewater systems for a theoretic occupancy of 174 people (per Rules). Actual occupancy in these 87 bedrooms is currently 75 people, equating to an occupancy rate of 0.86 individuals per bedroom. The combination of low per-capita water usage and low residency rates for these single-family homes has created loading rates in the disposal systems that we studied which are far below the current design requirements.

  Utilizing our best estimates. or actual engineering plans when available and our estimated water usage from the individual site water use surveys, we determined the average dispersal trench/bed loading rate to be 0.18 g/d/sq. ft. The maximum estimated one-day dispersal trench loading rate was observed in site No. 49 (an Advantex pretreatment system) at 0.59 g/d/sq. ft. in a single day.

  Estimated basal area loading rates for sites with mound systems averaged 0.054 g/d/sq. ft. The maximum estimated one-day basal area loading rate was 0.075 g/d/sq. ft. These loading rates were <u>well below the 0.24 g/d/sq. ft.</u> of basal area required by the Rules. The average estimated actual linear loading rate of the dispersal systems is 1.67 g/d/lin. ft., or <u>24% of the Rules-based flow linear loading rate</u>.

  The effects of the low dispersal trench and basal area and linear loading rates are clearly shown in our observations of the field characteristics of the disposal systems we studied:

  - No standing effluent in the dispersal trench stone was measured, with the exception of the failing system at site No. 7.

- No discernable, measurable biomat at the interface of the dispersal trench stone and mound sand/native soil interface was seen, with the exception of the failing system at site No. 7.
- An increased level of soil/mound sand moisture was seen immediately below the dispersal trenches. However, this moisture content decreased with depth until the native soil interface was encountered beneath the mound systems. A discernable increase in soil moisture was then seen at this depth. On only 1 individual occasion at four separate sites was a phreatic surface measured at or above this depth (interface between mound sand and underlying native soil).
- No evidence of mottling or other redoximorphic features were observed within the lower levels of the mound sand, just above the native soils. The limited incidence of groundwater presence above original ground surface measured during the study confirms the minimal time during which saturation occurs limiting the potential for creation of mottling in the mound sand.
- Many of the owners of disposal systems in our study have been using their current wastewater disposal systems for at least a decade. The lack of relict mottling or other evidence of surcharge/saturation throughout the dispersal trenches/beds and mound sand indicates that the effluent loading rates to these disposal systems have not overwhelmed their capability to disperse effluent.

- Six (6) of the 27 sites showed significant saturation of native soils beneath or immediately downgradient of the disposal areas, during the investigation period. These are the sites for which groundwater quality samples were obtained. Depth to groundwater and wastewater treatment efficiency are positively correlated (deeper levels of groundwater usually equal improved treatment). Sampling of saturated sites for chemical assessment provides a negative bias and conservative platform from

which to assess the effluent renovation efficacy of the systems. All the water quality data collected in this study indicates that each of these systems is providing substantial renovation of effluent within and immediately downgradient of the disposal areas. The water quality data clearly indicates that, compared to in-ground systems, mound systems provide better initial treatment directly beneath the dispersal area, and there is also more efficient subsequent renovation downgradient of the basal areas of the mounds.

Only one of the two advanced treatment systems in this study contained sufficient groundwater to sample (site No. 49, which has an Advantex textile system). The second advanced treatment system (site No. 18, which has a Presby disposal system), did not have sufficient groundwater to sample. The Advantex advanced treatment system at Site No. 49 uses a mound-type disposal area following treatment, and it exhibited reductions in total coliform bacteria, E. coli bacteria, and dissolved phosphorous similar to mound systems receiving septic-tank effluent.

The limited groundwater quality data provided by this study reveals that the disposal systems and soil treatment capabilities within several tens of feet of the initial effluent dispersal areas effectively reduce and/or eliminate both pathogen indicators and nutrients.

- Ten (10) of the 27 sites had confirmed curtain drain installations. These were checked on each of our site visits and rarely showed any evidence of groundwater discharge. No obvious correlation between curtain drain presence and IGM height was noted. Since most of the curtain drains were not discharging during the study period, we are not able to reach any conclusions regarding the efficacy or importance of curtain drains on challenging sites.

10.0 DESIGN RECOMMENDATIONS FOR NON-COMPLYING SITES

- A majority of the systems studied were designed and installation supervised by licensed on-site wastewater disposal system designers. The basic engineering parameters utilized by each of these designers and his years of practical experience in the field has resulted in an essential "default" system design utilized in the challenging soils associated with Addison County. Review of the data base and comparison of system designs indicates that the following generalized design parameters are utilized:

    - Ground slope between 7-18%;
    - Elevated "Mound" type disposal field;
    - Pressure distribution to within mound;
    - Linear loading rate using "Rules" based flow (150 gallons per bedroom per day) of less than 10 gallons per foot per day.
    - Dispersal area size equal to approximately one gallon of effluent per square foot per day based on "Rules" flow rates;
    - Basal area between 2,000-2,500 square feet;
    - Curtain drain installed upgradient of the disposal field.

- Continue to use, at a minimum, the design standards for absorption areas, water consumption, and basal area application rates. This is an aggressive approach based on estimated actual water consumption via the study related water use survey and associated estimated dispersal area loading rates. We do, however, recognize that there is a potential for single-family homes to be occupied at the Rule-based two individuals per bedroom for the first three bedrooms of a residence. Based on the measured IGM data from the study we anticipate that at this usage rate, the current Rules-based design standards for mound sizing could result in marginal efficacy of the system over the long term. Therefore, we suggest a "conservative" approach, utilizing dispersal trench loading rates of 0.25 to 0.5 g/d/sq. ft., coupled with mound

basal area loading rates of between 0.05 and 0.1 g/d/sq. ft. and a linear loading rate of less than 2 g/d/lin. ft. These conservative loading rates are based on typical estimated actual water usage rates at the sites we have studied, that showed no measurable or minimal measurable induced groundwater mounds. This resulted in significant unsaturated soil thicknesses beneath the disposal systems, and substantial effluent renovation within a very short distance downgradient from the dispersal areas.

- At a minimum, use raised bed “mound” systems on challenging sites in Addison County, to elevate the dispersal medium above the native ground surface, and to provide sufficient unsaturated soils for aerated wastewater treatment. The study results indicate that one foot of mound sand beneath the dispersal trenches is sufficient to provide appropriate effluent renovation and wastewater dispersal on challenging sites with indications of seasonal saturation (mottling) as close as 3 inches below the ground surface.

11.0 RECOMMENDATIONS FOR FURTHER DATA COLLECTION

The data collected during this study represents a “snapshot” of conditions from mid- to late-April through June 2007. This single seasonal monitoring should not be taken to represent average or typical conditions seen throughout Addison County during the spring. Although our results and evaluations indicate that the majority of the systems evaluated were functioning well and did not appear to be causing substantial risk to human health or the environment during our study periodt, multiple years of seasonal high water table monitoring would provide additional data regarding the range of operational parameters and groundwater fluctuations. This data could be used to fine-tune and/or further modify the design recommendations made above. H & N recommends the following be performed to enhance the data set initiated by our 2007 study:

- Contact each of the current participants in the study to discuss the potential of collecting data from the existing monitoring wells for at least one more seasonal high-water table season. Water-level dataloggers should be placed in the monitoring wells at each of the sites whose owners agree to additional data collection. The dataloggers should be installed no later than March 1, 2008, and should remain in place until June 1, 2008. Water quality samples should be obtained from MW-1 and one of the downgradient monitoring wells (MW-2 or MW-3) on or about the 15th of March, April, May, and June. The samples should be analyzed for total coliform, E. coli, and the nitrogen series (TKN, nitrate, nitrite, and ammonia).
- The ARCview/GIS database and data evaluation system developed as a part of this study should continue to be updated utilizing the data collected from the study sites, as well as any other sites deemed by DEC Regional Engineers to be appropriate for inclusion in long-term evaluation. The greater the suite of information, the more confidence can be placed in design rule modifications.

APPENDIX 1

MONKTON
STARKSBORO
FERRISBURGH
VERGENNES
PANTON
WALTHAM
BRISTOL
NEW HAVEN
LINCOLN
ADDISON
WEYBRIDGE
MIDDLEBURY
GRANVILLE
RIPTON
BRIDPORT
CORNWALL
SALISBURY
HANCOCK
SHOREHAM
WHITING
LEICESTER
GOSHEN
ORWELL

Code	Suitability	Description
Ia	Well suited	Soil map units with rapid permeability
Ib	Well suited	Soil map units with rapid permeability and limited slope
Ic	Well suited	Soil map units with moderate permeability
Id	Well suited	Soil map units with moderate permeability and limited slope
IIa	Moderately suited	Soil map units with slow permeability
IIb	Moderately suited	Soil map units with slow permeability and limited slope
IIc	Moderately suited	Soil map units with moderate depth to bedrock
IId	Moderately suited	Soil map units with moderate depth to bedrock and limited slope
IIe	Moderately suited	Soil map units with rapid permeability and steep slope
IIf	Moderately suited	Soil map units with moderate permeability and steep slope
IIg	Moderately suited	Soil map units with flooding limitation
IIh	Moderately suited	Soil map units with moderate depth to seasonal high water table (SHWT)
IIIa	Marginally suited	Soil map units with marginal depth to bedrock
IIIb	Marginally suited	Soil map units with flooding limitation and moderate depth to SHWT
IIIc	Marginally suited	Soil map units with marginal depth to SHWT and gentle slope
IIId	Marginally suited	Soil map units with marginal depth to SHWT and moderate slope
IIIe	Marginally suited	Soil map units with marginal depth to SHWT and limited slope
IIIf	Marginally suited	Soil map units with SHWT and depth to bedrock limitation
IVa	Not suited	Soil map units generally not suited due to excessive wetness
IVb	Not suited	Soil map units generally not suited due to limited depth to bedrock and steep slope
IVc	Not suited	Soil map units generally not suited due to very limited depth to bedrock on moderate slopes
IVd	Not suited	Soil map units generally not suited due to slow permeability and steep slope
V	Not rated	

Addison County Wastewater Disposal System Evaluation

NRCS Onsite Sewage Disposal Ratings

Addison County

0 1 2 4 Miles

Legend

Suitability for septic tank absorption fields

- Well suited
- Moderately suited
- Marginally suited
- Not rated
- Not suited

N W E S

Heindel and Noyes

Hydrogeology Ecology Environmental Engineering

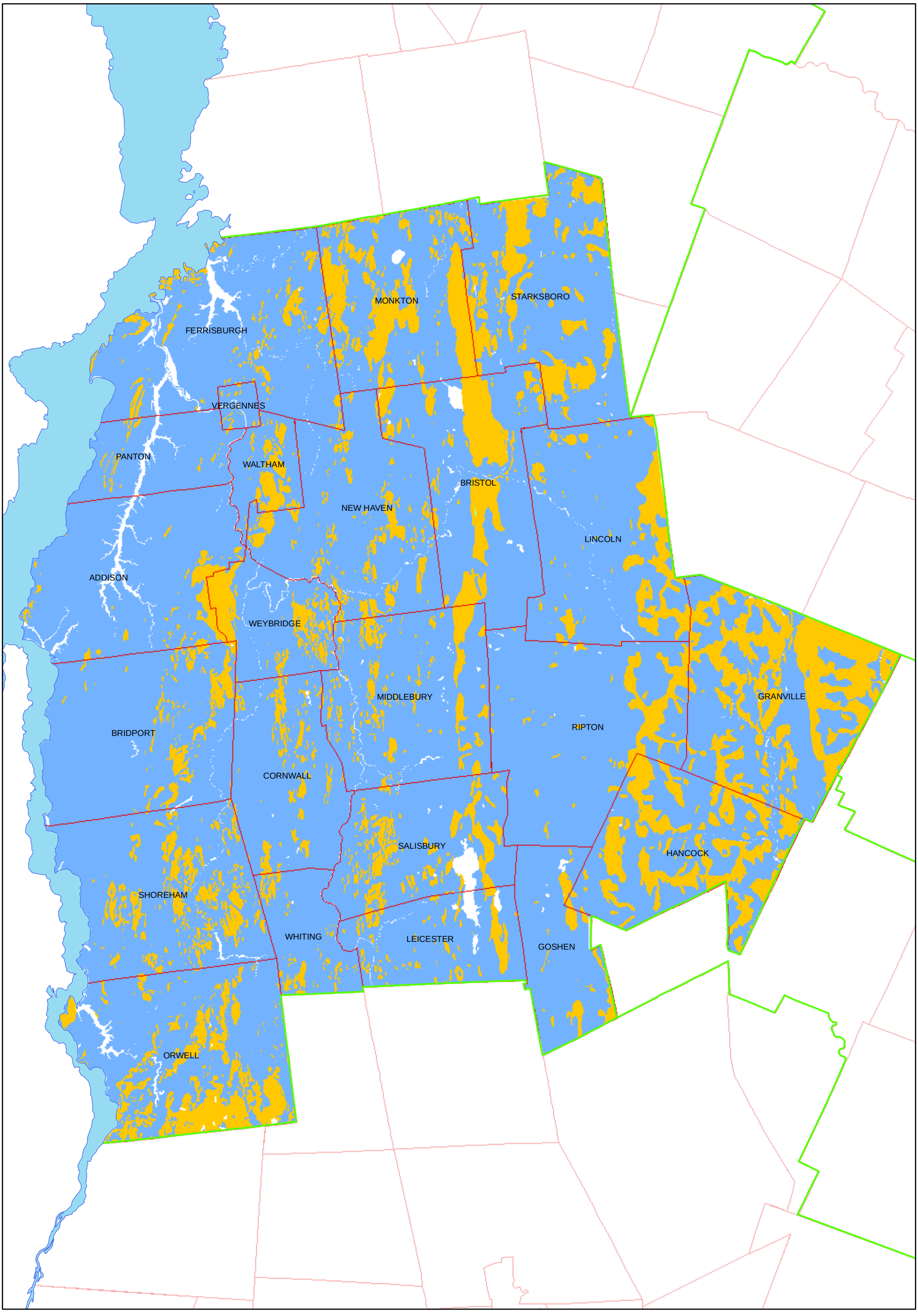
CONSULTING SCIENTISTS AND ENGINEERS

INFORMATION & VISUALIZATION SERVICES

November 12, 2007

Map produced by: M. Shellito

\\Poweredge\cadgis\Mshell\gis_projects\AddisonCnty_WastewaterEval\MXDs\OnsiteSewageDisposalRatings_11x17.mxd



Addison County Wastewater Disposal System Evaluation

Estimated Depth to Bedrock, NRCS (minimum)

Addison County

Legend

- 0"-20"
- 20"-40"
- 40"-60"

0 1 2 4 Miles

N W E S

Heindel and Noyes

● Hydrogeology ● Ecology ● ● Environmental Engineering ●

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November 12, 2007

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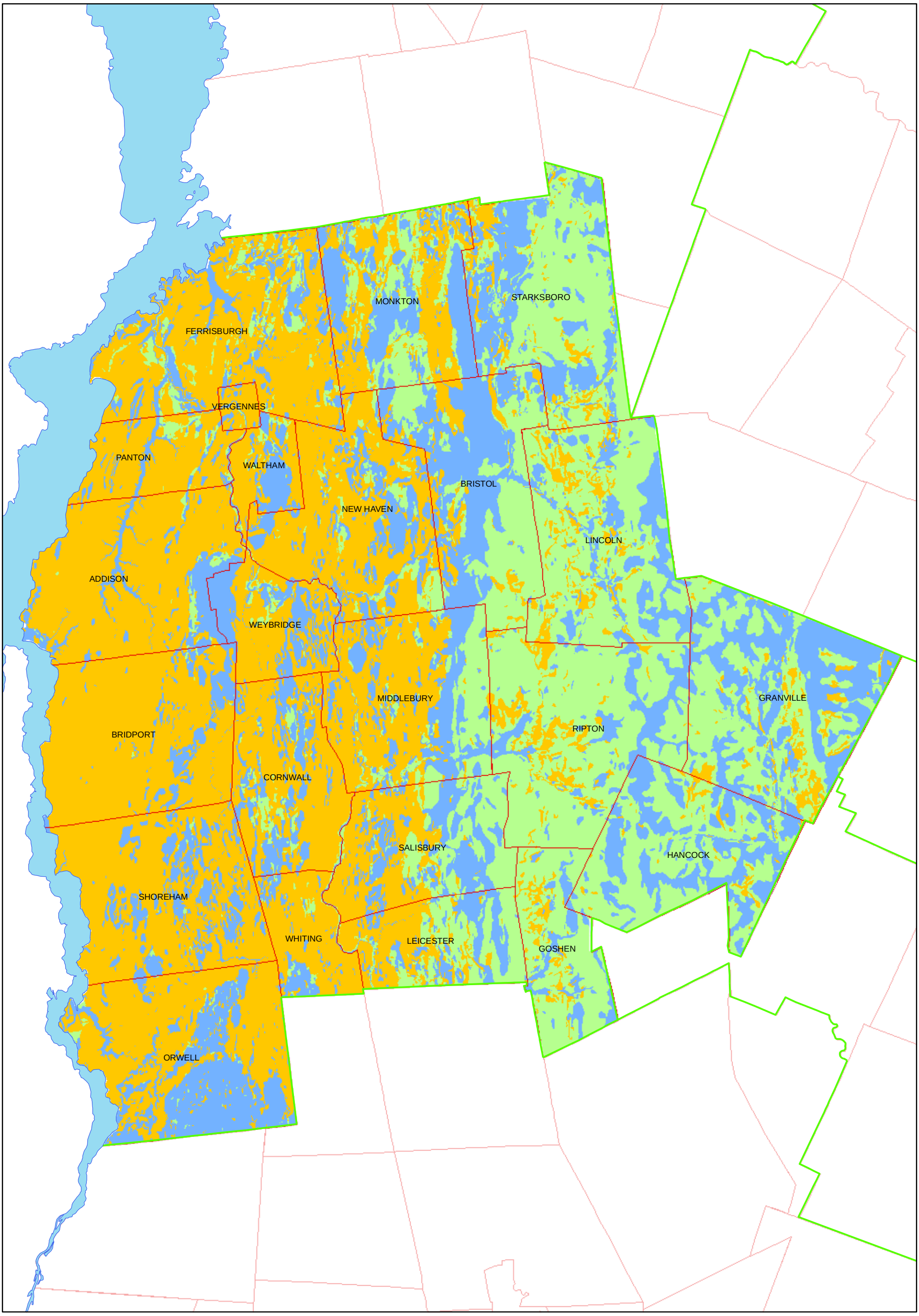

Addison County Wastewater Disposal System Evaluation

Estimated Depth to Water Table, NRCS (feet)

Addison County

Legend

- -1.0 - 1.0
- 1.1 - 3.0
- 3.1 - 99.9

0 1 2 4 Miles

November 12, 2007

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Addison County Wastewater Disposal System Evaluation

NRCS Representative Slope

Addison County

Slope gradient is the difference in elevation between two points, expressed as a percentage of the distance between those points.

In the underlying database, this attribute is actually recorded as three separate values. A low value and a high value indicate the range of this attribute for the corresponding component. A "representative" value indicates the expected value of this attribute for the corresponding component. For this soil property, only the representative value is used.

Legend

Representative Slope (percent)

- 1 - 5
- 5 - 20
- 20 - 30
- 30 - 60
- Not rated or not available

0 1.25 2.5 5 Miles

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Addison County Wastewater Study
NRCS Soil Characteristics
with Typical Wastewater Disposal Characteristics by Heindel and Noyes

Soil Series	Map Symbol	Map Symbol	NRCS Description	Drainage	Geologic Origin	Typical WW Disposal Characteristics (H&N):			
								CHALLENGING:	
						Excellent	Moderate	Difficult	Not Likely
Adams		Ad	loamy fine sand	excess.	water-lain shore deposits	X	X		
	AdA	Ad	loamy fine sand, 0 to 5 percent slopes				X		
	AdB	Ad	loamy fine sand, 5 to 12 percent slopes			X			
	AdD	Ad	loamy fine sand, 12 to 30 percent slopes			X			
	AdE	Ad	loamy fine sand, 30 to 50 percent slopes			X			
Amenia		Am, As	loam	mod.	till on limestone bedrock		X	X	
	AmB	Am	stony loam, 0 to 8 percent slopes				X	X	
	AmC	Am	stony loam, 8 to 15 percent slopes				X		
	AsC	As	extremely stony loam, 0 to 15 percent slopes				X	X	
	AsD	As	extremely stony loam, 15 to 25 percent slopes				X	X	X
Berkshire		Be, Bs	loam	well	till on schist		X	X	
	BeA	Be	stony loams, 0 to 3 percent slopes				X	X	
	BeB	Be	stony loams, 3 to 12 percent slopes				X		
	BeC	Be	stony loams, 12 to 25 percent slopes				X		
	BsC	Bs	extremely stony loams, 3 to 20 percent slopes				X		
	BsE	Bs	extremely stony loams, 20 to 50 percent slopes					X	X
Buckland		Bu	loam	mod.	till on schist or limestone		X		
	BuC	Bu	extremely stony loam, 3 to 15 percent slopes				X		
	BuD	Bu	extremely stony loam, 15 to 25 percent slopes				X		
Cabot		Ca, Cb	loam	poor	till on schist or limestone		X	X	
	CaB	Ca	stony loam, 0 to 8 percent slopes				X	X	
	CbC	Cb	extremely stony loam, 0 to 15 percent slopes				X	X	
Calais-Glover		Cl	loam	well	till on schist or limestone		X		
	ClC	Cl	soils, 5 to 20 percent slopes				X		
	ClE	Cl	soils, 20 to 50 percent slopes				X		
Canandaigua		Cn	silt loam	poor	bottom sediments		X	X	X
	Cn	Cn	silt loam				X	X	X
Cobbly Alluvial Land		Co	sand, gravel, cobblestone	well to poor	recent alluvium	X	X	X	
	Co	Co	alluvial land			X	X	X	
Colton		Ct	gravelly sandy loam	excess.	water-lain deposits		X	X	
	CtA	Ct	gravelly sandy loam, 0 to 5 percent slopes				X	X	
	CtB	Ct	gravelly sandy loam, 5 to 12 percent slopes				X		
	CtD	Ct	gravelly sandy loam, 12 to 30 percent slopes				X		
	CtE	Ct	gravelly sandy loam, 30 to 50 percent slopes					X	X

See NOTES on last page of table.

Addison County Wastewater Study
NRCS Soil Characteristics
with Typical Wastewater Disposal Characteristics by Heindel and Noyes

Soil Series	Map Symbol	Map Symbol	NRCS Description	Drainage	Geologic Origin	Typical WW Disposal Characteristics (H&N):			
						Excellent	Moderate	CHALLENGING: Difficult	CHALLENGING: Not Likely
Covington		Cv	silty clay	poor	bottom sediments		X	X	X
	Cv	Cv	silty clay, flooded					X	X
Covington-Panton		Cw	silty clay	poor	bottom sediments		X	X	X
	Cw	Cw	silty clays				X	X	X
Duane		Da	fine sandy loam	mod.	water-lain deposits		X	X	
	DaA	Da	fine sandy loam, 0 to 5 percent slopes				X	X	
	DaB	Da	fine sandy loam, 5 to 12 percent slopes				X		
Dutchess		Dc, Ds	loam	well	till on slate bedrock		X	X	
	DcB	Dc	stony loam, 3 to 8 percent slopes				X	X	
	DcC	Dc	stony loam, 8 to 15 percent slopes				X		
	DcD	Dc	stony loam, 15 to 25 percent slopes				X		
	DsC	Ds	extremely stony loam, 3 to 15 percent slopes				X		
	DsE	Ds	extremely stony loam, 15 to 50 percent slopes					X	X
Elmwood series, coarse variant		El	fine sandy loam	mod.	bottom sediments, shores		X	X	
	ElB	El	fine sandy loam, coarse variant, 0 to 8 percent slope				X	X	
	ElC	El	fine sandy loam, coarse variant, 8 to 15 percent slope				X		
Farmington		Fa	silt loam	excess.	till on limestone bedrock		X	X	
	FaC	Fa	extremely rocky silt loam, 5 to 20 percent slopes				X	X	
	FaE	Fa	extremely rocky silt loam, 20 to 50 percent slopes				X	X	X
Farmington, mod. deep variant		Fd	silt loam	well	till on limestone bedrock		X	X	
	FdB	Fd	stony silt loam, mod. deep variant, 3 to 8 percent slopes				X	X	
	FdC	Fd	stony silt loam, mod. deep variant, 8 to 15 percent slopes				X		
	FdD	Fd	stony silt loam, mod. deep variant, 15 to 25 percent slopes				X		
	FdE	Fd	stony silt loam, mod. deep variant, 25 to 50 percent slopes				X	X	X
Farmington-Nellis		Fn	silt loam and loam	well	till on limestone bedrock		X	X	
	FnB	Fn	rocky complex, 5 to 12 percent slopes				X	X	
	FnC	Fn	rocky complex, 12 to 20 percent slopes				X		
	FnD	Fn	rocky complex, 20 to 30 percent slopes				X	X	
Fresh water marsh		Fw	clay or silt under shallow water	saturated	bottom seds or alluvium				X
	Fw	Fw	fresh water marsh						X
Gravel Pit		Gp	gravel	excess.	water-lain	X	X		
	Gp	Gp	Gravel pits			X	X		
Hadley		Hf	very fine sandy loam	well	recent alluvium	X	X	X	
	Hf	Hf	very fine sandy loam			X	X	X	
Hadley frequenty flooded		Hh	very fine sandy loam	mod.	recent alluvium		X	X	
	Hh	Hh	very fine sandy loam, frequently flooded				X	X	X
Limerick		Le, Lh	silt loam or clay	poor	bottom sediments		X	X	
	Le	Le	silt loam				X	X	
	Lh	Lh	clay				X	X	

See NOTES on last page of table.

Addison County Wastewater Study
NRCS Soil Characteristics
with Typical Wastewater Disposal Characteristics by Heindel and Noyes

Soil Series	Map Symbol	Map Symbol	NRCS Description	Drainage	Geologic Origin	Typical WW Disposal Characteristics (H&N):			
						Excellent	Moderate	CHALLENGING: Difficult	CHALLENGING: Not Likely
Livingston flooded		Lk	clay	very poor	bottom sediments		X	X	X
	Lk	Lk	clay, flooded				X	X	X
Lyman-Berkshire		Lm, Lx	loam	excess.	till on schist		X	X	
	LmB	Lm	rocky complex, 5 to 12 percent slopes				X	X	
	LmC	Lm	rocky complex, 12 to 20 percent slopes				X		
	LxC	Lx	very rocky complex, 5 to 20 percent slopes				X		
	LxE	Lx	very rocky complex, 20 to 50 percent slopes					X	X
Massena		Ma, Mn	silt loam	poor	till on limestone bedrock		X	X	
	MaA	Ma	stony silt loam, 0 to 3 percent slopes				X	X	
	MnB	Mn	extremely stony silt loam, 0 to 8 percent slopes				X	X	
Melrose		Mr	fine sandy loam	well	bottom sediments		X	X	
	MrA	Mr	fine sandy loam, 0 to 3 percent slopes				X	X	
	MrB	Mr	fine sandy loam, 3 to 8 percent slopes				X		
	MrC	Mr	fine sandy loam, 8 to 15 percent slopes				X		
	MrD	Mr	fine sandy loam, 15 to 25 percent slopes				X		
	MrE	Mr	fine sandy loam, 25 to 50 percent slopes					X	X
Muck and peat		My	organic material (muck and peat)	saturated	former ponds				X
	Mv	Mv	Muck and Peat						X
Nassau-Dutchess		Na, Nd	loam or silt loam	excess.	till on slate		X	X	
	NaB	Na	rocky complex, 3 to 8 percent slopes				X	X	
	NaC	Na	rocky complex, 8 to 15 percent slopes				X		
	NaD	Na	rocky complex, 15 to 25 percent slopes				X		
	NdC	Nd	extremely rocky silt loam, 3 to 25 percent slopes				X	X	
Nellis		Ne, Ns	loam	well	till on limestone		X	X	
	NeB	Ne	stony loam, 3 to 8 percent slopes				X	X	
	NeC	Ne	stony loam, 8 to 15 percent slopes				X		
	NeD	Ne	stony loam, 15 to 25 percent slopes				X		
	NsC	Ns	extremely stony loam, 3 to 15 percent slopes				X		
	NsD	Ns	extremely stony loam, 15 to 50 percent slopes					X	X
Peru		Pe, Ps	loam	mod.	till on schist		X	X	
	PeA	Pe	stony loam, 0 to 5 percent slopes				X	X	
	PeB	Pe	stony loam, 5 to 12 percent slopes				X		
	PeC	Pe	stony loam, 12 to 20 percent slopes				X		
	PsC	Ps	extremely stony loam, 0 to 20 percent slopes				X	X	
	PsD	Ps	extremely stony loam, 20 to 50 percent slopes					X	X
Quarry		Qu	quarry	NA	varied	X	X	X	X
	Qu	Qu	quarry			X	X	X	X

See NOTES on last page of table.

Addison County Wastewater Study
NRCS Soil Characteristics
with Typical Wastewater Disposal Characteristics by Heindel and Noyes

Soil Series	Map Symbol	Map Symbol	NRCS Description	Drainage	Geologic Origin	Typical WW Disposal Characteristics (H&N):			
						Excellent	Moderate	CHALLENGING: Difficult	CHALLENGING: Not Likely
Rubble land		RL	rubble land	NA	varied			X	X
	RL	RL	rubble land					X	X
Raynham		Ra	silt loam	poor	bottom sediments		X	X	
	RaB	Ra	silt loam, 0 to 6 percent slopes				X	X	
	RaC	Ra	silt loam, 6 to 12 percent slopes				X	X	
	RaD	Ra	silt loam, 12 to 25 percent slopes				X	X	
Rock land		Rk	rock land	NA	shallow to bedrock			X	X
	Rk	Rk	rock land					X	X
Salmon		Sa	very fine sandy loam	well	bottom sediments		X	X	
	SaB	Sa	very fine sandy loam, 2 to 6 percent slopes				X	X	
	SaC	Sa	very fine sandy loam, 6 to 12 percent slopes				X		
	SaE	Sa	very fine sandy loam, 12 to 50 percent slopes				X	X	X
Stetson		St	gravelly fine sandy loam	excess.	water-lain	X	X		
	StA	St	gravelly fine sandy loam, 0 to 5 percent slopes			X	X	X	
	StB	St	gravelly fine sandy loam, 5 to 12 percent slopes			X	X		
	StD	St	gravelly fine sandy loam, 12 to 30 percent slopes			X	X		
	StE	St	gravelly fine sandy loam, 30 to 50 percent slopes				X	X	X
Swanton		Sw	fine sandy loam	poor	bottom sediments		X	X	
	Sw	Sw	fine sandy loam				X	X	
Vergennes		Vg	clay	poor	bottom sediments		X	X	
	VgB	Vg	clay, 2 to 6 percent slopes					X	
	VgC	Vg	clay, 6 to 12 percent slopes				X	X	
	VgD	Vg	clay, 12 to 25 percent slopes				X	X	
	VgE	Vg	clay, 25 to 50 percent slopes				X	X	X
Vergennes, mod. shallow variant		Vr	clay	mod.	bottom sediments		X	X	
	VrB	Vr	rocky clay, mod. shallow variant, 2 to 6 percent slopes					X	
	VrC	Vr	rocky clay, mod. shallow variant, 6 to 12 percent slopes				X	X	
	VrD	Vr	rocky clay, mod. shallow variant, 12 to 25 percent slopes				X	X	
Water									
	W	W	water	NA					X
Walpole		Wa	silt loam	poor	water-lain		X	X	
	Wa	Wa	silt loam				X	X	
Winooski		Wo	very fine sandy loam	mod.	alluvium	X	X	X	
	Wo	Wo	very fine sandy loam			X	X	X	

See NOTES on last page of table.

Addison County Wastewater Study
NRCS Soil Characteristics
with Typical Wastewater Disposal Characteristics by Heindel and Noyes

Soil Series	Map Symbol	Map Symbol	NRCS Description	Drainage	Geologic Origin	Typical WW Disposal Characteristics (H&N):			
								CHALLENGING:	
						Excellent	Moderate	Difficult	Not Likely

NOTES:

Drainage: from NRCS descriptions: poor = poorly or somewhat poorly drained; mod. = moderately or somewhat moderately well-drain
excess. = excessively or somewhat excessively drained; well = well-drained.

Geologic Origin: interpreted by H&N.

Typical Wastewater Disposal Characteristics (estimated by H&N)

Excellent: Usually in-ground systems; high hydraulic conductivity, deep water table

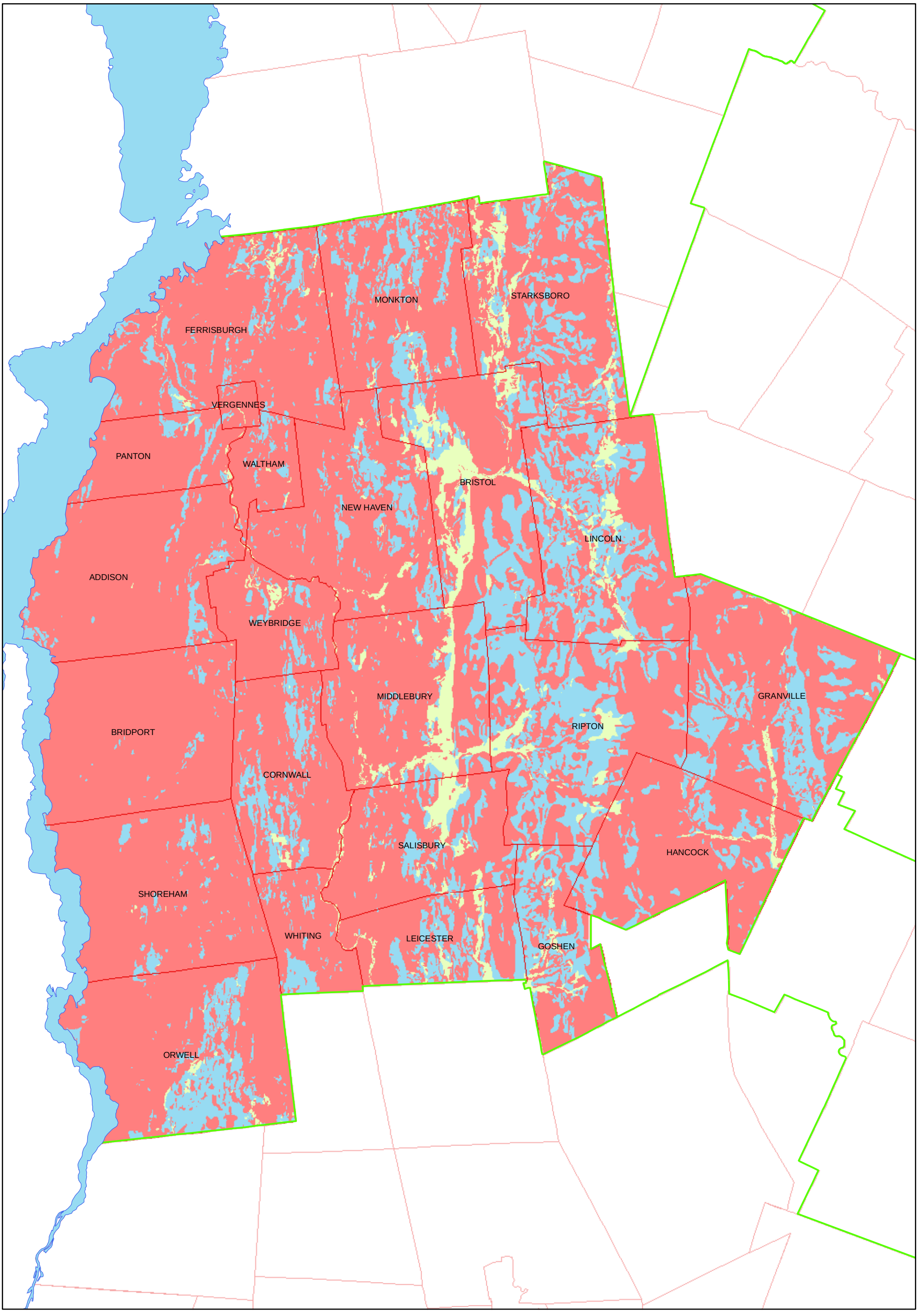
Moderate: Sometimes in-ground, sometimes at-grade or mound; moderate hydraulic conductivity, moderate to deep water table, moderate slop

CHALLENGING WASTEWATER DISPOSAL CHARACTERISTICS:

Difficult: Only mound systems, sometimes nothing possible in compliance with rules; moderate to low hydraulic conductivity, shallow to moderate water table
moderate to very low slopes.

Not Likely: generally nothing possible in compliance with rules; low hydraulic conductivity, shallow to water table, thin or non-existent soils, very low slope

See NOTES on last page of table.



Addison County Wastewater Disposal System Evaluation

Typical Wastewater Disposal Characteristics (H&N)

Addison County

November 12, 2007

Map produced by: M. Shellito

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Legend

Typical Wastewater Disposal Characterizations (by H&N)

- Excellent
- Moderate
- Challenging

0 1 2 4 Miles

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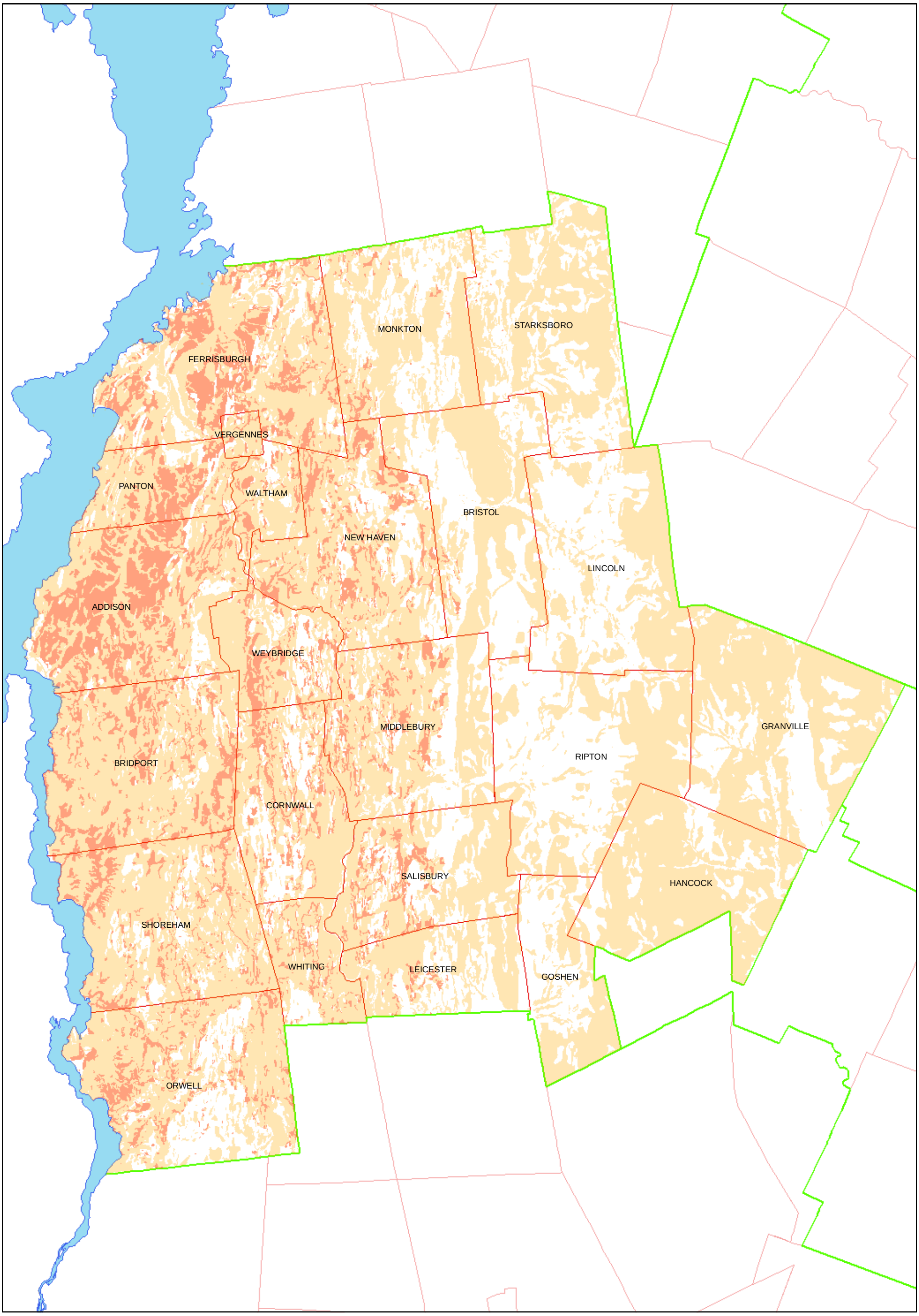

Addison County Wastewater Disposal System Evaluation

Comparisons of Typical Wastewater Disposal Characteristics (H&N)

Addison County

November 12, 2007

Map produced by: M. Shellito

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Potentially challenging areas for on-site disposal suitability

Challenging site conditions meeting all three criteria below

Challenging site conditions meeting two out of the three criteria below

Three site criteria:

1. Depth to water table (shallow): 0.1 to 1 foot
2. Representative slope: less than 3% or greater than 30%
3. Challenging soils based on soil texture, soil moisture, and slope as defined by H&N

0 1 2 4 Miles

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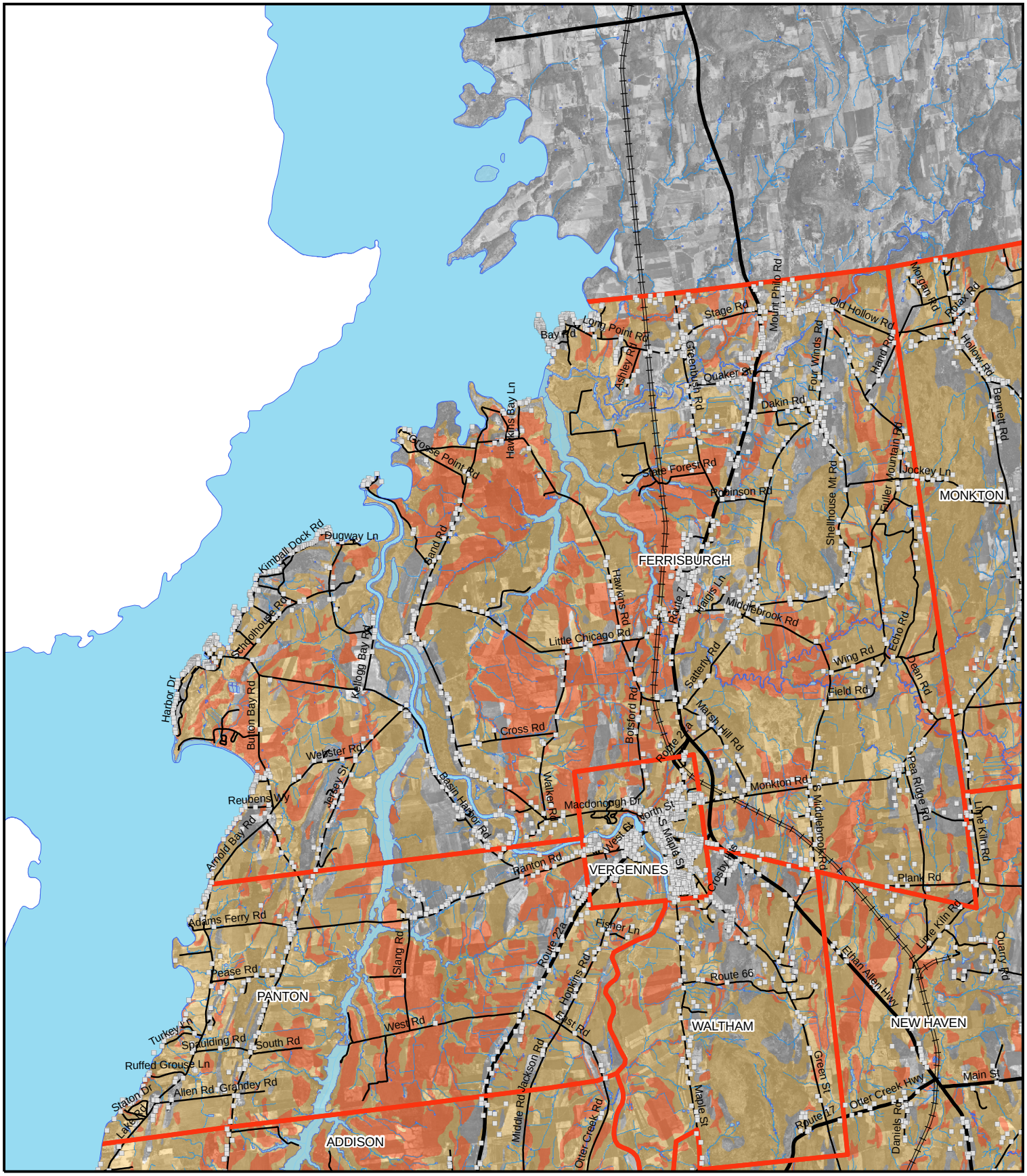

Addison County Wastewater Disposal System Evaluation

FERRISBURGH

Addison County

Potentially challenging areas for septic suitability

- Challenging septic soil types meeting all three criteria below
- Challenging septic soil types meeting two out of the three criteria below

Soils analysis criteria:

- Depth to water table (shallow): 0.1 to 1 foot
- Representative slope: less than 3% and greater than 30%
- Challenging soils as defined by H&N

(Based on soil texture, soil moisture, and slope)

0 0.5 1 2 Miles

Heindel and Noyes
Hydrogeology • Ecology • Environmental Engineering
CONSULTING SCIENTISTS AND ENGINEERS
INFORMATION & VISUALIZATION SERVICES

Feb 12, 2007

Map produced by: M. Shellito

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Heindel & Noyes, Inc.
P.O. Box 4503 Burlington, VT 05406-4503

- Consulting Hydrogeologists
- Engineers
- Environmental Scientists

Voice 802-658-0820/Fax 802-860-1014

March 5, 2007

<Contact>
<mailing address>
<Town>, VT <zip>

RE: Addison County Wastewater Disposal System Study

Dear <Greeting>:

As you may be aware, the 2006 Vermont General Assembly appropriated funding to conduct an evaluation of wastewater disposal systems in Addison County to see what soil, site or design characteristics contribute to the success or failure of these systems. This aim of the study is to determine whether a reliable system could be constructed on sites which do not meet the performance standards of the current Wastewater System and Potable Water Supply Rules.

Heindel and Noyes was recently chosen to complete this work and we are seeking your help. An important component of this project will be assessing a representative number of existing septic systems located at sites with challenging soil conditions. We are therefore looking for residents of Addison County who would be willing to participate by having their systems studied. There should be no disruption to your use of the system and no time commitment other than an initial conversation with a member of the project team. Our results will be kept confidential and any reference to your system in our final report will maintain your anonymity.

We would ask that you complete the enclosed questionnaire and return it in the envelope we have supplied. You could also send a reply by email to Murphy@q-city.com. It is important that we hear from you whether you wish to participate or not in the study, although of course we hope you will. If you are chosen, you will be contacted and provided further details.

If you have any questions, please feel free to contact me by email or at 802-658-0820 (ext. 19) or by 802-734-0292 after normal working hours. I thank you in advance for your cooperation.

Best Regards,

Sean Murphy
Senior Scientist

Enclosure

Heindel & Noyes, Inc.
P.O. Box 4503 Burlington, VT 05406-4503

- Consulting Hydrogeologists
- Engineers
- Environmental Scientists

Voice 802-658-0820/Fax 802-860-1014

Addison County Wastewater Disposal System Study

Questionnaire

I ____am / ____ am not willing to participate in the Addison County Wastewater Disposal System Study. I understand that if I do take part in this study my participation and the results of the evaluation of my system will be kept confidential and that any reference to my system in official reports or documents will maintain my anonymity.

Name:

Address:

Questions for those who are willing to participate in Study

1. **My water system ____ is / ___ is not metered.**
2. **My wastewater system is approximately _____ years old.**
3. **There are currently ____ people living in my home / utilizing my septic system.**
4. **My system ____ has / ____ has not experienced surfacing.**
5. **My wastewater system ____ does / ____ does not experience difficulties in the Springtime or during cold water conditions.**
6. **My system ____ was / ___ was not designed by a certified professional.**
7. **My system ____ was / ___ was approved by the State or Town prior to installation.**
8. **I ____ do / ___ do not have a copy of the system design plans.**
9. **My system is considered innovative. ____ Yes / ____ No / ____ Don't know**

   If yes, please provide additional details.

Thank you for your participation.

Hello, I am calling from Heindel and Noyes. You recently returned a survey indicating your willingness to participate in the Addison County Wastewater Disposal System Study. I am calling today to get some background information and ask you some questions and talk about how to best do a site visit. Is this a good time to talk?

Name:
Phone:
911 Address:
How long have you owned the residence?

Is your water supplied by a municipality or water district?
If so, are you metered?

If not, what type of water supply do you have (drilled bedrock, shallow dug, spring)?

Where is the well located?

What is the current occupancy (full time residence)?
How many years has it been at this occupancy?
What was the previous occupancy (if different)? For how long?
Number of bedrooms: Number of bathrooms:

Washing machine	____	Garbage disposal	____
Dish Washer	____	Slop sink	____
Water Softener	____	Water softener discharge location:	

Septic tank type (steel, concrete):
Septic tank size (gallons):
When was it last pumped?
Did you get a report on the tank pump out?
Is there access to the tank at grade?

Is there a pump station? Can pump station be accessed at grade?
Pump station size (gallons):
When was maintenance last done?:

Is there a curtain drain? Does the drain flow water?

Where is your septic system located?

What type of system to you have (mound, in-ground, etc)?

Date of septic system installation: Name of Engineer:

Do you have a Town permit for system? Do you have a State permit?

Has leachfield been maintained (mowed, drainage away during rain)?

Is there access to leachfield pipes from grade?
Have you ever noticed ponded water or wet areas in leachfield?
Have you ever notices septic odors?
Has your system ever backed into the house or had slow drainage?
Does the pump station alarm go off?

Was there ever any other septic systems at the residence?

Could a “bobcat” get from road to leachfield?

Heindel & Noyes, Inc.
P.O. Box 4503 Burlington, VT 05406-4503

- Consulting Hydrogeologists
- Engineers
- Environmental Scientists

Voice 802-658-0820/Fax 802-860-1014

Dear Property Owner

Thank you for your participation in the Addison County Wastewater Disposal System Study. The information we gather from your property will be essential in evaluation of wastewater treatment options in this area of Vermont. Your cooperation is greatly appreciated. Attached to this letter is an Access Agreement. The agreement describes the work to be performed and our insurance coverage. Please review the agreement, sign where indicated and return to our office in the self addressed stamped envelope provided.

As you have likely noticed, we have installed several temporary monitoring wells in and adjacent to your wastewater disposal system. We will be monitoring these wells for water level changes and obtaining samples for laboratory analyses over the next several weeks. We anticipate visiting your property weekly for at least one month. In addition to collecting data from the monitoring wells, we would like to get an idea of the water usage habits in your household. Included in this packet is a Water Use Estimate Survey. We ask that you fill in the interior water usage categories on a daily basis for one week. Several outside use categories are also included and can be estimated for the week. If you have a metered water supply we ask that you record the meter reading several times during the week you track water use. This information is going to be crucial to evaluating the wastewater systems “loading” with water during normal use. Once the week of water use tracking is complete please send the survey back to our office.

The postage on the enclosed self addressed stamped envelope is sufficient for both the access agreement and the water use survey, so please feel free to send both at the same time.

Once again H&N is grateful for the opportunity to utilize your property for this important study. If you have any questions, please feel free to contact me by email or at 802-658-0820 (ext. 25); slarosa@q-city.com; or at 802-223-3389 after normal working hours

Best Regards,

Steven LaRosa
Senior Scientist

Enclosure

AGREEMENT FOR MONITORING ACCESS

The State of Vermont Dept. of Environmental Conservation (the "State") has retained Heindel & Noyes, Inc. (H & N) to perform an investigation of wastewater disposal systems in Addison County. The study's objective is to identify wastewater disposal systems currently operating at sites that could not be developed under today's State regulations. The design and function of these systems will be evaluated to determine what specific design or site conditions have allowed for effective system operation.

Your property has been identified as an excellent candidate to fulfill this study's objective. In order to best define the functioning characteristics of your wastewater disposal system H & N is proposing the installation and sampling of groundwater monitoring wells in and adjacent to your wastewater disposal system. You (the "Owner") grant H & N access to the property for the installation, sampling, and (ultimately) abandonment of the groundwater monitoring well. The well will be installed and monitored in accordance with the conditions detailed below.

1. Installation of the wells shall be conducted in a manner that minimizes the potential for damage or interference with the existing on-site septic system.

2. Any monitoring well installed shall be maintained by H & N at its sole expense. At the conclusion of the study, the wells shall be removed and properly closed by H & N in accordance with State regulations.

3. Owner shall have no liability whatsoever to H & N or the State of Vermont arising from installation of, damage to or termination of the groundwater monitoring wells.

4. H & N will maintain professional and general liability insurance in the amount of at least $1 Million Dollars.

5. H & N will protect the confidentiality and anonymity of the owner throughout the study process. Once the agreement is finalized, the Owner's property will be referenced only as a letter and number, *i.e.* "A-1", in all research and reporting requirements of the study contract.

6. H & N shall provide Owner with a copy of the final report related to this research once it is approved by the State.

Your participation in this study is greatly appreciated and the information gathered from your property will be vital in the evaluation of wastewater disposal alternatives throughout the Addison County region.

HEINDEL & NOYES, INC.

By: _____ Date:_____, 2007
Its authorized agent

OWNER (Printed name:_____)

_____ Date:_____, 2007
Signature

_____ Date:_____, 2007
Signature

Heindel and Noyes, Inc.

Water Use Estimate Survey

Addison County Wastewater Study Property Number: _____

Name: _____

Telephone Number: _____

Dates of Survey Period:		**thru**	

Interior Water Uses

Water Use	Frequency	Monday	Tuesday	Wednesday	Thursday
Bath/Shower	number per day				
Clothes Washer	loads per day				
Dish Washer	loads per day				
Toilets	flushes per day				

Water Use	Frequency	Friday	Saturday	Sunday
Bath/Shower	number per day			
Clothes Washer	loads per day			
Dish Washer	loads per day			
Toilets	flushes per day			

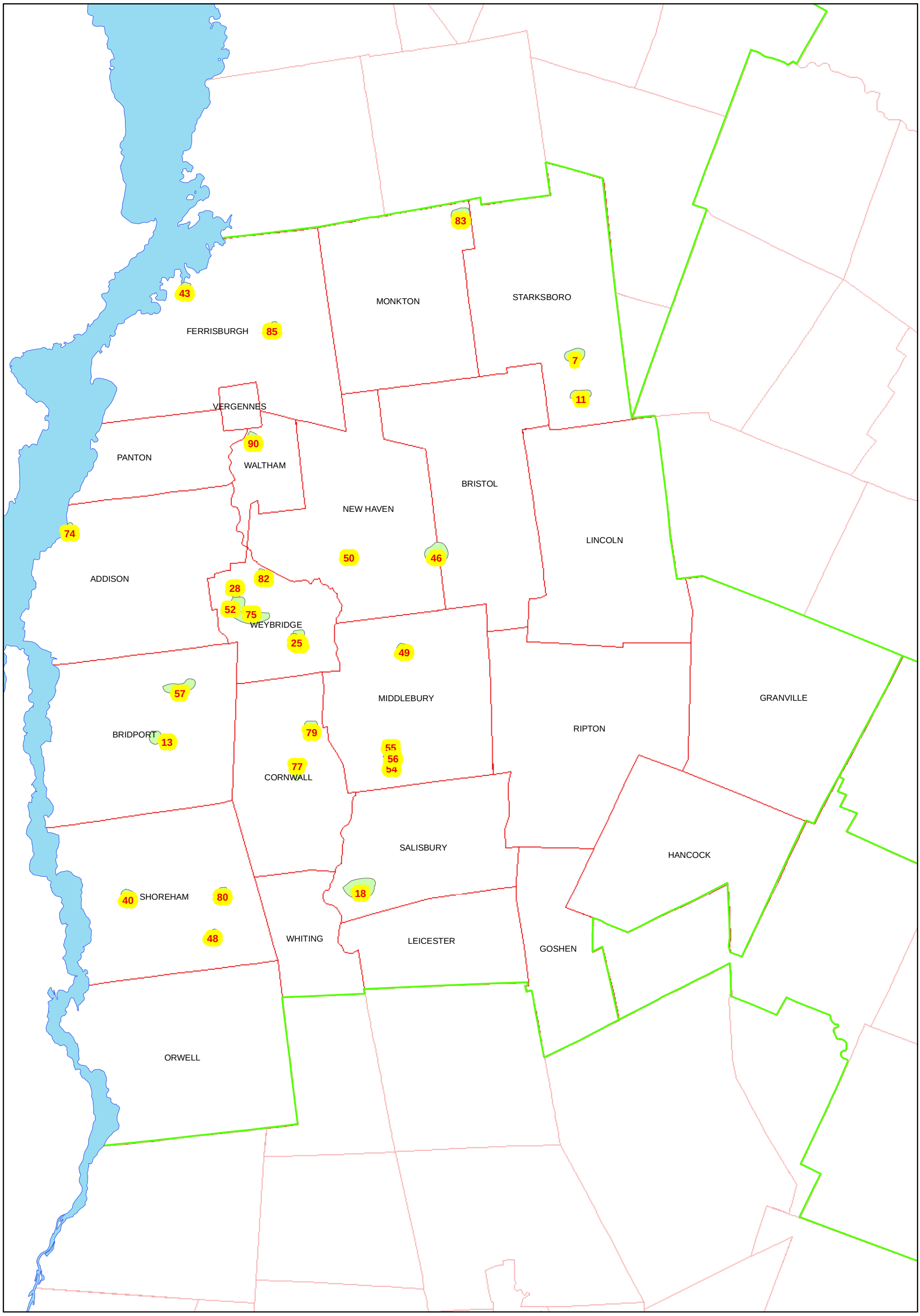
Exterior Water Uses

Car Washes	number per week		
Lawn/Garden Watering	hours per week		
Other High Water Uses (animal watering, etc)	hours of use per week or gallons of use per week		Notes:

Water Service Flow Meter (if present)

Reading	Date

APPENDIX 2



Addison County Wastewater Disposal System Evaluation

Participating Sites (27)

Addison County

November 6, 2007

Map produced by: M. Shellito

\\Poweredge\cadgis\Mshell\gis_projects\AddisonCnty_WastewaterEval\MXDs\Selected_Sites_11x17.mxd

Legend

Participating Sites

0 1.25 2.5 5 Miles

N W E S

Heindel and Noyes

Hydrogeology Ecology Environmental Engineering

CONSULTING SCIENTISTS AND ENGINEERS

INFORMATION & VISUALIZATION SERVICES

Addison County Wastewater Study

Summary of Selected Site Use Data

	Residence Occupancy Data					
Site ID.	Town	Length of Ownership (years)	Current Residents	Years at Current Occupancy	Previous Residents	Years at Previous Occupancy
7	Starksboro	17	3	5	5	12
11	Starksboro	8	2	8	0	20
13	Bridport	31	2	8	4	0
18	Salisbury	5	2	5	0	0
25	Weybridge	8	4	8	0	0
28	Weybridge	28	2	6	3	4
40	Shoreham	6	5	5	4	1
43	Ferrisburg	16	5	1	3	5
46	New Haven	8	2	2	4	4
48	Shoreham	30	2	17	3	0
49	Middlebury	4	3	4	0	0
50	New Haven	3	2	3	4	4
52	Weybridge	4	3	4	2	2
54	Middlebury	18	3	18	0	0
55	Middlebury	22	2	2	3	20
56	Middlebury	3	2	3	0	0
57	Bridport	13	4	13	0	0
74	Addison	13	1	2	0	0
75	Weybridge	5	4	2	5	3
77	Cornwall	10	2	0.1	5	8
79	Cornwall	5	4	5	0	0
80	Whiting	2	3	2	0	0
82	Weybridge	38	3	0	0	0
83	Monkton	6	4	4	3	2
84	Weybridge	8	0	0	0	0
85	Ferrisburg	18	4	18	0	0
90	Waltham	4	2	4	0	0

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N/A = Not applicable
UNK = Unknown
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Dispersal Area = Estimated stone bed/trench area
Basal Area = Bed/trench length times distance from bed/trench to mound toe

Addison County Wastewater Study

Summary of Selected Site Use Data

	Water Use Related Data										
Site ID.	Bedrooms	Rules/Design Based Flow (gpd)	Bathrooms	Washing Machine	Dishwasher	Garbage Disposal	Utility Sink	Water Softener	Water Softener Discharge Location	Water Supply Type	Metered
7	4	490	1	Y	N	N	N	N	NA	DRILLED	N
11	3	420	2.5	Y	Y	N	Y	N	NA	DUG WELL	N
13	3	420	1	Y	Y	Y	N	N	NA	TOWN	Y
18	2	420	2	Y	Y	N	N	Y	PERIMTER DRAIN	DRILLED	N
25	3	420	2	Y	Y	N	N	Y	UNK	DRILLED	Y
28	5	560	3	Y	Y	N	N	Y	SEPTIC	DRILLED	N
40	4	490	2	Y	Y	N	N	N	NA	TOWN	Y
43	7	700	5	Y	Y	N	N	Y	SEPTIC	DRILLED	N
46	3	420	2	Y	Y	N	Y	Y	PERIMETER DRAIN	DRILLED	N
48	3	420	1	Y	Y	N	N	Y	SEPTIC	DRILLED	N
49	3	420	2.5	Y	Y	N	Y	Y	PERIMETER DRAIN	DRILLED	N
50	3	420	2	Y	Y	Y	N	Y	SEPTIC	DRILLED	N
52	3	420	2	Y	Y	Y	N	Y	UNK	DRILLED	N
54	3	420	2	Y	Y	Y	N	Y	SEPTIC	DRILLED	N
55	3	420	2.5	Y	Y	Y	N	Y	UNK	DRILLED	N
56	4	490	2.5	Y	Y	Y	N	Y	SEPTIC	DRILLED	NA
57	3	420	2	Y	Y	N	N	N	NA	TOWN	Y
74	3	420	2.5	N	Y	N	N	N	NA	TOWN	Y
75	3	420	2	Y	Y	N	N	N	NA	DRILLED	N
77	3	420	1.5	Y	N	N	N	Y	SEPTIC	DRILLED	N
79	4	490	2.5	Y	Y	N	N	N	NA	DRILLED	N
80	3	420	3	Y	Y	N	N	Y	SEPTIC	DRILLED	N
82	3	420	1	Y	N	N	N	N	NA	DRILLED	N
83	3	420	1	Y	Y	N	N	Y	SEPTIC	DRILLED	N
84	0	100	0	Y	Y	N	Y	Y	UNK	DRILLED	N
85	3	420	2	Y	N	N	Y	N	NA	DRILLED	N
90	3	420	3.75	Y	Y	N	N	N	NA	TOWN	Y

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Addison County Wastewater Study

Summary of Selected Site Use Data

	Water Use Related Data						
Site ID.	Estimated Actual Average Water Use per Week (g/wk)	Estimated Actual Average Water Use per Day (gpd)	Estimated Actual Maximum Water Use in One Day (gpd)	Estimated Actual Average Water Use per Day per Bedroom (gpd)	Estimated Actual Maximum Water Use in One Day per Bedroom (gpd)	Estimated Actual Average Water Use per Day per Person (gpd)	Estimated Actual Maximum Water Use in One Day per Person (gpd)
7	679	97	137	24.3	34.3	32.3	45.7
11	792	113	163	37.7	54.3	56.6	81.5
13	710	101	195	33.8	65.0	50.7	97.5
18	734	105	108	52.4	54.0	52.4	54.0
25	1178	168	175	56.1	58.3	42.1	43.8
28	790	113	174	22.6	34.8	56.4	87.0
40	906	129	160	32.4	40.0	25.9	32.0
43	1246	178	209	25.4	29.9	35.6	41.8
46	540	77	120	25.7	40.0	38.6	60.0
48	692	99	170	33.0	56.7	49.4	85.0
49	889	127	237	42.3	78.8	42.3	78.8
50	385	55	72	18.3	24.0	27.5	36.0
52	870	124	115	41.4	38.3	41.4	38.3
54	504	72	115	24.0	38.3	24.0	38.3
55	388	55	101	18.5	33.7	27.7	50.5
56	825	118	171	29.5	42.8	58.9	85.5
57	1434	205	210	68.3	70.0	51.2	52.5
74	200	29	50	9.5	16.7	28.6	50.0
75	1105	158	201	52.6	67.0	39.5	50.3
77	377	54	79	18.0	26.3	26.9	39.5
79	1240	177	235	44.3	58.8	44.3	58.8
80	545	78	140	26.0	46.7	26.0	46.7
82	742	106	95	35.3	31.7	35.3	31.7
83	0	0	0	0.0	0.0	0.0	0.0
84	207	30	47	N/A	N/A	9.9	15.7
85	0	0	0	0.0	0.0	0.0	0.0
90	800	114	131	38.1	43.7	57.1	65.5

- Estimated Actual Average Water Use per Week = H&N Water Use Survey Calculated Water Use
  (shower = 20 gallons; washing machine = 25 gallons per load; dish washer = 15 gallons per load; toilet = 3 gallons per flush)
-Estimated Actual Average Water Use per day = Estimated Actual Average Water Use per Week (gallons) / 7 days
-Estimated Actual Maximum Water Use per Day = H&N Water Use Survey Single Day Maximum (gallons)
-Estimated Actual Average Water Use per Day per Bedroom = Estimated Actual Average Water Use per Week (gallons) / # Bedrooms in Residence
-Estimated Actual Maximum Water Use in One Day per Bedroom (gpd) = Estimated Actual Maximum Water Use in One Day / # Bedrooms in Residence
-Estimated Actual Average Water Use per Day per Person = Estimated Actual Average Water Use per Week (gallons) / # Persons in Residence
-Estimated Actual Maximum Water Use in One Day per Bedroom (gpd) = Estimated Actual Maximum Water Use in One Day / # Persons in Residence

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Addison County Wastewater Study

Summary of Selected Site Use Data

	Wastewater System Design Data									
Site ID.	Approximate Wastewater System Age (years)	Date of Installation	Replacement System	Designed by Certified Professional	Town Permit	Design Permitted by VDEC	Wastewater System Type	Septic Tank Type	Septic Tank size (gal)	Access to Septic Tank at Grade?
7	17	1990	N	Y	N	N	INGROUND	CONCRETE	1000	N
11	8	1998	Y	Y	Y	UNK	INGROUND	CONCRETE	1000	Y
13	31	1976	UNK	Y	Y	Y	MOUND	CONCRETE	1000	Y
18	4	2003	N	Y	Y	N	PRESBY	CONCRETE	1000	Y
25	8	1999	Y	Y	Y	Y	MOUND	CONCRETE	1000	Y
28	26	1981	Y	N	N	N	INGROUND	CONCRETE	1000	N
40	6	2001	Y	N	N	N	INGROUND	CONCRETE LEDGE	1000	Y
43	8	1999	Y	Y	Y	Y	MOUND	CONCRETE	1500	Y
46	8	1999	N	Y	Y	Y	MOUND	CONCRETE	1000	N
48	3.5	2002	Y	N	N	N	INGROUND	CONCRETE	1000	Y
49	4	2002	N	Y	Y	N	ADVANTEX	CONCRETE	1000	Y
50	7	2000	N	Y	Y	Y	MOUND	CONCRETE	1000	N
52	14	UNK	Y	Y	Y	Y	MOUND	UNK	UNK	Y
54	3	2004	N	Y	UNK	UNK	GRAVITY MOUND	CONCRETE	1000	Y
55	22	1985	N	Y	UNK	UNK	GRAVITY MOUND	CONCRETE	1000	N
56	28	1979	N	Y	UNK	UNK	GRAVITY MOUND	CONCRETE	1000	N
57	3	1994	N	Y	UNK	UNK	INGROUND	CONCRETE	1000	N
74	2	2005	N	Y	UNK	UNK	MOUND	CONCRETE	1000	N
75	5	2002	Y	Y	UNK	UNK	MOUND	CONCRETE	1000	N
77	3	2004	Y	Y	UNK	UNK	MOUND	CONCRETE	1000	Y
79	4	2002	Y	Y	UNK	UNK	MOUND	CONCRETE LEDGE	1000	Y
80	3	2004	Y	Y	UNK	UNK	MOUND	CONCRETE	1000	N
82	7	2000	Y	Y	UNK	UNK	MOUND	CONCRETE	1000	N
83	2	2005	Y	Y	UNK	UNK	MOUND	CONCRETE	1000	N
84	8	1999	UNK	Y	Y	Y	MOUND	CONCRETE	1000	N
85	18	1989	N	Y	UNK	UNK	INGROUND	CONCRETE	1000	N
90	4	2003	N	Y	UNK	UNK	MOUND	CONCRETE	1000	Y

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Basal Area = Bed/trench length times distance from bed/trench to mound toe

Addison County Wastewater Study

Summary of Selected Site Use Data

	Wastewater System Design Data							Soils Data					
Site ID.	Years Since Last Septic Tank Pumping	Pump Station	Pump Station Size (gal)	Access to Pump Station at Grade?	Last maintenance	Curtain Drain	Drain Flow Noted?	NRCS Mapped Soil Type	Transmitting Soil Type	Transmitting Soil Consistence	Transmitting Soil Structure	Depth to Mottling (inches)	Slope (%)
7	2	N	NA	NA	NA	Y	Y	PsC	Silty Fine Sand	Firm	Granular	4	8
11	5	N	NA	NA	NA	N	NA	BsC	Very Fine Sand	Firm	Granular	6	10
13	UNK	N	NA	NA	NA	N	NA	FdC	Silty Clay	Firm	Blocky	4	14
18	UNK	Y	1000	Y	UNK	N	NA	FaC	Sandy Loam	Friable	Blocky	5	8
25	3	Y	1000	Y	NEVER	N	NA	NeB	Silt Loam	Firm	Blocky	6	15
28	2	N	NA	NA	NA	N	NA	VgD	Loam	Firm	Blocky	4	11
40	3	Y	UNK	UNK	UNK	UNK	UNK	FdB	Silty Clay	Firm	Granular	4	4
43	2.5	Y	UNK	Y	2006	UNK	UNK	VgB	Silty Loam	Firm	Blocky	3	15
46	NEVER	Y	2 COMPARTMENT	N	NEVER	Y	UNK	VgB	Clay	Hard	Blocky	3	3
48	NEVER	N	NA	NA	NA	N	NA	VgB	Clay	Firm	Blocky	3	7.5
49	NEVER	Y	1000	Y	2006	Y	UNK	VgE	Silt Loam	Firm	Blocky	6	8
50	3	Y	1000	Y	UNK	Y	Y	VgB	Silt Loam	Hard	Blocky	4	7
52	2	Y	UNK	N	2005	N	NA	VgC	Sandy Loam	Friable	Granular	3	18
54	2	N	NA	NA	NA	N	NA	FaE	Silt Loam	Friable	Granular	3	18
55	UNK	N	NA	NA	NA	N	NA	FaE	Silt Loam	Friable	Granular	3	16
56	1	N	NA	NA	NA	N	NA	FaC	Silt Loam	Friable	Granular	3	20
57	1-2	N	NA	NA	NA	N	NA	VgB	Silt Loam	Friable	Blocky	3	7
74	UNK	Y	1000	N	UNK	Y	UNK	VgB	Silty Clay	Firm	Blocky	3	15
75	NEVER	Y	1000	N	UNK	Y	UNK	VgB	Silt Loam	Firm	Blocky	4	15
77	NEVER	Y	1000	Y	NEVER	Y	UNK	VgB	Clay	Hard	Blocky	5	15
79	NEVER	Y	1000	N	NEVER	N	NA	NeB	Loam	Friable	Granular	9	14
80	UNK	Y	1000	N	UNK	Y	N	VgB	Silt Loam	Friable	Blocky	10	14
82	UNK	Y	1000	N	UNK	N	NA	Cn	Silty Clay	Firm	Blocky	6	15
83	NEVER	Y	1000	N	UNK	Y	N	RaC	Silt Loam	Firm	Granular	21	18
84	3	Y	1000	Y	NEVER	N	NA	VgB	Sandy Loam	Friable	Granular	6	12
85	2	N	NA	NA	NA	N	NA	BeC	Silt Loam	Friable	Granular	4	11
90	1	Y	1000	N	UNK	Y	N	VgB	Silty Clay	Hard	Blocky	10	14

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Addison County Wastewater Study

Summary of Selected Site Use Data

	Wastewater System Loading Data									
Site ID.	Approximate Disposal Area Length (feet)	Estimated "Rule Based Flow" Linear Loading Rate (g/ft/d)	Estimated "Actual Flow" Linear Loading Rate (g/ft/d)	Approximate Dispersal Area Size (sq. ft.)	Estimated Actual Average Dispersal Trench Loading Rate (g/sq. ft./d)	Estimated Actual Maximum One Day Dispersal Trench Loading Rate (g/sq. ft./d)	Approximate Basal Area Size (sq. ft.)	Estimated Actual Average Basal Area Loading Rate (g/sq. ft./d)	Estimated Actual Maximum One Day Basal Area Loading Rate (g/sq. ft./d)	Average Induced Groundwater Mound (ft)
7	90	5	1	1000	0.10	0.14	0	0.000	0.000	1.87
11	50	8	2	600	0.19	0.27	0	0.000	0.000	N/A
13	52	8	2	1000	0.10	0.20	3224	0.031	0.060	N/A
18	60	7	2	900	0.12	0.12	0	0.000	0.000	N/A
25	67	6	3	629	0.27	0.28	1500	0.112	0.117	-0.04
28	30	19	4	840	0.13	0.21	0	0.000	0.000	N/A
40	75	7	2	780	0.17	0.21	0	0.000	0.000	-0.71
43	65	11	3	1200	0.15	0.17	4000	0.045	0.052	1.04
46	100	4	1	440	0.18	0.27	1705	0.045	0.070	1.19
48	77	5	1	612	0.16	0.28	0	0.000	0.000	N/A
49	50	8	3	400	0.32	0.59	1250	0.102	0.189	2.06
50	50	8	1	500	0.11	0.14	1272	0.043	0.057	N/A
52	50	8	2	500	0.25	0.23	2000	0.062	0.058	0.35
54	45	9	2	672	0.11	0.17	1200	0.060	0.096	N/A
55	40	11	1	480	0.12	0.21	900	0.062	0.112	N/A
56	50	10	2	500	0.24	0.34	2280	0.052	0.075	N/A
57	52	8	4	420	0.49	0.50	0	0.000	0.000	-1.00
74	105	4	0.3	420	0.07	0.12	2415	0.012	0.021	N/A
75	102	4	2	408	0.39	0.49	2448	0.064	0.082	1.21
77	110	4	0.5	440	0.12	0.18	2167	0.025	0.036	N/A
79	50	10	4	500	0.35	0.47	1400	0.127	0.168	N/A
80	130	3	1	494	0.16	0.28	3419	0.023	0.041	N/A
82	50	8	2	416	0.25	0.23	2184	0.049	0.043	1.08
83	80	5	0.0	492	0.00	0.00	2460	0.000	0.000	1.48
84	75	1	0.4	500	0.06	0.09	1800	0.016	0.026	N/A
85	125	3	0.0	1770	0.00	0.00	0	0.000	0.000	2.19
90	140	3	1	420	0.27	0.31	2660	0.043	0.049	2.18

- Estimated "Rule Based Flow" Linear Loading Rate (g/ft/d) = Rules/Design Based Flow / Approximate Disposal Area Length
- Estimated "Actual Flow" Linear Loading Rate (g/ft/d) = Estimated Actual Average Water Use per Day / Approximate Disposal Area Length
- Estimated Actual Average Dispersal Trench Loading Rate (g/sq. ft./d) = Approximate Dispersal Area / Estimated Actual Average Water Use per Day
- Estimated Actual Maximum One Day Dispersal Trench Loading Rate (g/sq. ft./d) = Approximate Dispersal Area / Estimated Actual Maximum Water Use in One Day
- Estimated Actual Average Basal Area Loading Rate (g/sq. ft./d) = Approximate Basal Area / Estimated Actual Average Water Use per Day
- Estimated Actual Maximum One Day Basal Area Loading Rate (g/sq. ft./d) = Approximate Basal Area / Estimated Actual Maximum Water Use in One Day
- Average Induced Groundwater Mound Height = from Separate Calculation Table Presented in Appendix 2 Page 12

Y = Yes
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Addison County Wastewater Study

Summary of Selected Site Use Data

	Wastewater System Observation Data					
Site ID.	Leachfield Mowed	Difficulties in Spring	Ponded Water or Wet Areas Noted	Septic Odors Noted	Backup into House or Slow Drainage	Wastewater System "Failing" by Visual Observation of Owner or H&N
7	Y	N	Y	Y	N	Y
11	Y	N	N	N	N	N
13	Y	N	N	N	N	N
18	Y	N	N	N	N	N
25	Y	N	N	N	N	N
28	Y	N	N	N	N	N
40	UNK	N	N	N	N	N
43	Y	N	N	N	N	N
46	Y	N	N	N	N	N
48	Y	N	N	N	N	N
49	Y	N	N	N	N	N
50	Y	N	N	N	N	N
52	Y	N	N	N	N	N
54	Y	N	N	N	N	N
55	Y	N	N	N	N	N
56	Y	N	N	Y	N	N
57	Y	N	N	N	Y	N
74	Y	UNK	N	N	N	N
75	Y	UNK	N	N	N	N
77	Y	N	N	Y	Y	N
79	Y	N	N	Y	Y	N
80	Y	N	Y	N	N	N
82	Y	UNK	N	N	N	N
83	Y	UNK	N	N	N	N
84	Y	UNK	N	N	N	N
85	SEE NOTES	UNK	N	N	N	N
90	Y	UNK	Y	N	N	Y

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Basal Area = Bed/trench length times distance from bed/trench to mound toe

Addison County Wasterwater Study

Depth to Groundwater
(feet below ground surface)

Site	System Type/ Depth to Mottles (in. below grade)	4/23/2007	5/10/2007	5/11/2007	5/16/2007	5/24/2007	6/1/2007	6/11/2007
7	In-Ground							
MW-1	6.in.		1.38		0.41	1.25	> 1.38	> 1.38
MW-2	10.in.		> 3.25		0.56	3.00	> 3.25	> 3.25
MW-3	10.in.		> 3.67		3.16	> 3.67	> 3.67	> 3.67
11	In-Ground							
MW-1	6.in.		> 3.00		> 3.00	> 3.00	> 3.00	> 3.00
MW-2	6.in.		> 3.66		> 3.66	> 3.66	> 3.66	> 3.66
MW-3	10.in.		> 3.25		> 3.25	> 3.25	> 3.25	> 3.25
13	Mound							
MW-1	18.in.	> 5.33		> 5.33	> 5.33	> 5.33	> 5.33	> 5.33
MW-2	4.in.	> 3.00		> 3.00	> 3.00	> 3.00	> 3.00	> 3.00
MW-3	6.in.	2.94		> 3.17	> 3.17	> 3.17	> 3.17	> 3.17
18	Presby Mound							
MW-1	30.in.	> 4.08		> 4.08	> 4.08	> 4.08	> 4.08	> 4.08
MW-2	5.in.	> 3.25		> 3.25	> 3.25	> 3.25	> 3.25	> 3.25
MW-3	5.in.	> 3.25		> 3.25	> 3.25	> 3.25	> 3.25	> 3.25
25	Mound							
MW-1	41.in.	6.72	> 6.75		> 6.75	> 6.75	> 6.75	> 6.75
MW-2	6.in.	3.57	> 3.50		> 3.50	> 3.50	> 3.50	> 3.50
MW-3	6.in.	2.96	> 2.92		> 2.92	> 2.92	> 2.92	> 2.92
MW-4			> 4.72		> 4.72	> 4.72	> 4.72	> 4.72
28	In-Ground							
MW-1	4.in.		> 3.65		> 3.65	> 3.65	> 3.65	> 3.65
MW-2	12.in.		> 4.08		> 4.08	> 4.08	> 4.08	> 4.08
MW-3	18.in.		> 2.91		> 2.91	> 2.91	> 2.91	> 2.91
40	In-Ground							
MW-1	4.in.			2.11	2.12	2.13	2.42	2.26
MW-2	4.in.			0.78	0.77	1.22	1.55	1.50
MW-3	4.in.			1.57	1.68	1.80	1.69	2.38
43	Mound							
MW-1	17.in.	1.84		3.76	3.09	> 3.25	> 3.25	> 3.25
MW-2	0.in.	0.45		1.70	1.35	1.71	2.20	2.40
MW-3	0.in.	0.05		1.36	0.71	1.49	1.98	2.18
46	Mound							
MW-1	6.in.	2.99	> 3.50		> 3.50	> 3.50	> 3.50	> 3.50
MW-2	3.in.	2.60	> 3.50		> 3.50	> 3.50	> 3.50	> 3.50
MW-3	3.in.	1.75	> 4.00		> 4.00	> 4.00	> 4.00	> 4.00
MW-4	36.in.	n/a	> 3.40		> 3.40	> 3.40	> 3.40	> 3.40
48	In-Ground							
MW-1	3.in.	3.97		4.12	> 4.33	> 4.33	> 4.33	> 4.33
MW-2	6.in.	2.49		2.91	3.24	> 3.33	> 3.33	> 3.33
MW-3	4.in.	1.81		2.29	2.62	2.92	> 3.25	> 3.25
49	Advantex Mound							
MW-1	32.in.	3.44	3.42		3.62	3.61	3.67	3.67
MW-2	6.in.	2.89	2.61		2.78	2.88	2.97	3.83
MW-3	6.in.	1.14	2.38		1.85	2.26	2.54	3.42

Addison County Wasterwater Study

Depth to Groundwater
(feet below ground surface)

Site	System Type/ Depth to Mottles (in. below grade)	4/23/2007	5/10/2007	5/11/2007	5/16/2007	5/24/2007	6/1/2007	6/11/2007
50	Mound							
MW-1	24.in.	> 3.25	> 3.25		> 3.25	> 3.25	> 3.25	> 3.25
MW-2	18.in.	1.14	2.03		1.60	2.65	> 3.17	> 3.17
MW-3	10.in.	1.02	1.83		3.16	2.41	> 3.09	> 3.09
MW-4	36.in.		> 3.42		> 3.42	> 3.42	> 3.42	> 3.42
52	Mound							
MW-1	22.in.	4.24	3.95		4.08	2.76	4.01	3.77
MW-2	4.in.	2.44	0.62		0.44	0.70	0.63	0.66
MW-3	4.in.	1.58	0.78		0.43	0.52	0.56	0.43
54	Gravity Mound							
MW-1	18.in.			> 4.59	> 4.59	> 4.59	> 4.59	> 4.59
MW-2	4.in.			> 4.25	> 4.25	> 4.25	> 4.25	> 4.25
MW-3	4.in.			> 3.33	> 3.33	> 3.33	> 3.33	> 3.33
55	Gravity Mound							
MW-1	46.in.			> 4.00	> 4.00	> 4.00	> 4.00	> 4.00
MW-2	12.in.			> 2.26	> 2.26	> 2.26	> 2.26	> 2.26
MW-3	4.in.			> 1.65	> 1.65	> 1.65	> 1.65	> 1.65
MW-4				> 3.42	> 3.42	> 3.42	> 3.42	> 3.42
56	Gravity Mound							
MW-1	36.in.			> 3.67	> 3.67	> 3.67	> 3.67	> 3.67
MW-2	6.in.			> 2.17	> 2.17	> 2.17	> 2.17	> 2.17
MW-3	2.in.			1.68	1.61	2.41	> 3.58	> 3.58
MW-4				> 3.42	> 3.42	> 3.42	> 3.42	> 3.42
57	In-Ground							
MW-1	15.in.			1.95	1.47	1.92	2.20	1.77
MW-2	3.in.			0.53	0.63	0.73	1.10	0.74
MW-3	3.in.			0.70	0.78	1.11	1.30	1.00
74	Mound							
MW-1	36.in.		> 4.59		> 4.59	> 4.59	> 4.59	> 4.59
MW-2	3.in.		2.95		> 3.58	> 3.58	> 3.58	> 3.58
MW-3	3.in.		2.37		3.27	> 3.59	3.41	> 3.59
75	Mound							
MW-1	44.in.		3.29		3.87	3.97	> 4.25	> 4.25
MW-2	4.in.		1.37		1.95	1.99	2.36	2.99
MW-3	4.in.		2.28		2.13	1.80	1.84	> 3.83
MW-4	44.in.		> 4.00		> 4.00	> 4.00	> 4.00	> 4.00
77	Mound							
MW-1	49.in.			> 4.90	> 4.90	> 4.90	> 4.90	> 4.90
MW-2	5.in.			> 3.34	> 3.34	> 3.34	> 3.34	> 3.34
MW-3	5.in.			> 3.34	> 3.34	> 3.34	> 3.34	> 3.34
MW-4	51.in.			> 4.83	> 4.83	> 4.83	> 4.83	> 4.83
79	Mound							
MW-1	32.in.			> 3.25	> 3.25	> 3.25	> 3.25	> 3.25
MW-2	9.in.			> 2.50	> 2.50	> 2.50	> 2.50	> 2.50
MW-3	12.in.			> 3.00	> 3.00	> 3.00	> 3.00	> 3.00
MW-4				> 3.58	> 3.58	> 3.58	> 3.58	> 3.58
80	Mound							
MW-1	34.in.			> 4.37	> 4.37	> 4.37	> 4.37	> 4.37
MW-2	10.in.			> 3.67	> 3.67	> 3.67	> 3.67	> 3.67
MW-3	12.in.			> 3.83	> 3.83	> 3.83	> 3.83	> 3.83

Addison County Wasterwater Study

Depth to Groundwater
(feet below ground surface)

Site	System Type/ Depth to Mottles (in. below grade)	4/23/2007	5/10/2007	5/11/2007	5/16/2007	5/24/2007	6/1/2007	6/11/2007
82	Mound							
MW-1	27.in.		3.03		3.72	2.92	2.15	> 4.50
MW-2	6.in.		1.45		1.74	1.78	2.13	2.73
MW-3	6.in.		1.49		1.55	1.85	2.31	2.83
83	Mound							
MW-1	36.in.		> 4.17		> 4.17	4.00	> 4.17	3.84
MW-2	30.in.		3.05		2.45	1.83	2.33	2.65
MW-3	21.in.		2.51		0.94	1.12	1.80	> 4.00
84	Mound							
MW-1	42.in.	> 4.75	> 4.75		> 4.75	> 4.75	> 4.75	> 4.75
MW-2	6.in.	> 3.84	> 3.84		> 3.84	> 3.84	> 3.84	> 3.84
MW-3	6.in.	> 3.16	> 3.16		> 3.16	> 3.16	> 3.16	> 3.16
MW-4	45.in.	> 4.55	> 4.55		> 4.55	> 4.55	> 4.55	> 4.55
85	Mound							
MW-1	24.in.			1.70			2.95	3.17
MW-2	4.in.			3.03	3.05	> 3.75	> 3.75	> 3.75
MW-3	4.in.			2.28	0.42	1.20	1.79	2.15
90	Mound							
MW-1	32.in.			3.2	3.69	3.51	> 4.25	> 4.25
MW-2	10.in.			2.77	2.44	2.67	3.01	3.32
MW-3	10.in.			3.28	3.24	3.45	3.73	> 4.00

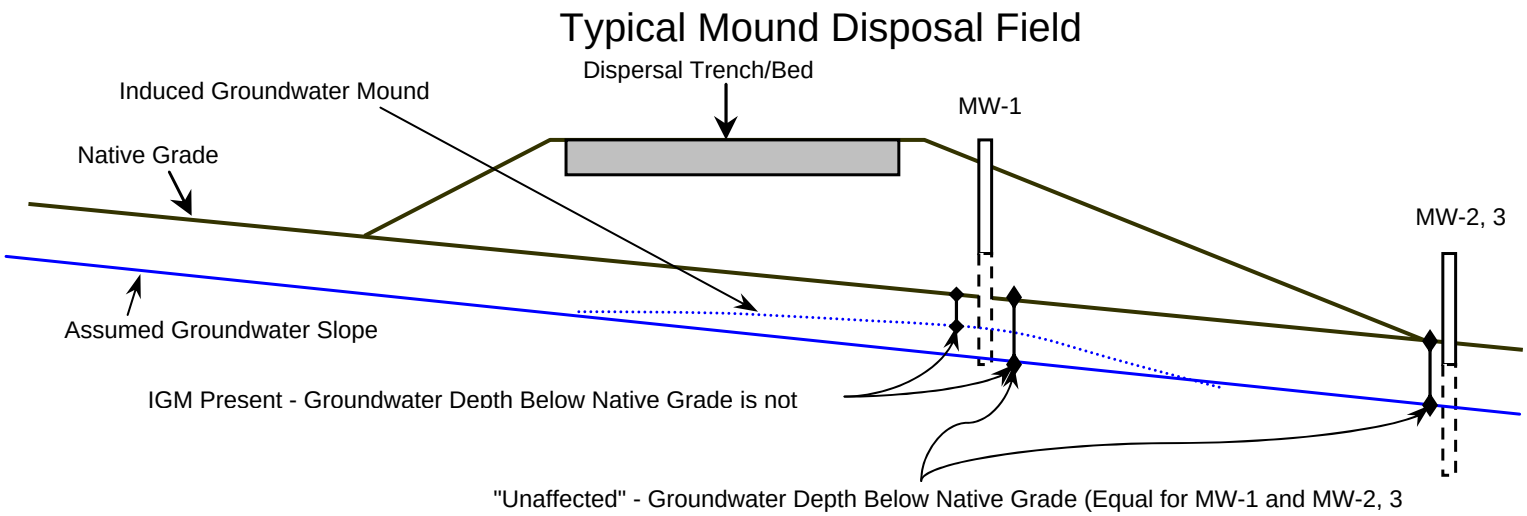
Addison County Wastewater Study

Groundwater Elevations Relative to Original Ground Surface
and
Calculated Induced Groundwater Mound (IGM) Heights
(feet)

Site	System Type/ Depth to Native Soil (ft. below current grade)	4/23/2007	5/10/2007	5/11/2007	5/16/2007	5/24/2007	6/1/2007	6/11/2007	Average Induced Groundwater Mound Height (feet)
7	In-Ground								
MW-1	0.0		-1.4		-0.4	-1.3			
MW-2	0.0		-> 3.25		-0.6	-3.0			
MW-3	0.0		-> 3.67		-3.2	-> 3.67			
	IGM Height (feet)		> 2.08		1.45	2.09			1.87
25	Mound								
MW-1	3.4	-3.30							
MW-2	0.0	-3.57							
MW-3	0.0	-2.96							
MW-4									
	IGM Height (feet)	-0.04							-0.04
40	In-Ground								
MW-1	0.0			-2.1	-2.1	-2.1	-2.4	-2.3	
MW-2	0.0			-0.8	-0.8	-1.2	-1.6	-1.5	
MW-3	0.0			-1.6	-1.7	-1.8	-1.7	-2.4	
	IGM Height (feet)			-0.94	-0.90	-0.62	-0.80	-0.32	-0.71
43	Mound								
MW-1	3.0	1.2		-0.8	-0.1				
MW-2	0.0	-0.5		-1.7	-1.4				
MW-3	0.0	-0.1		-1.4	-0.7				
	IGM Height (feet)	1.41		0.77	0.94				1.04
46	Mound								
MW-1	2.0	-1.0							
MW-2	0.0	-2.6							
MW-3	0.0	-1.8							
MW-4									
	IGM Height (feet)	1.19							1.19
48	In-Ground								
MW-1	0.0	-2.0		-2.12					
MW-2	0.0	-2.5		-2.91					
MW-3	0.0	-1.8		-2.29					
	IGM Height (feet)	0.18		0.48					0.33
49	Advantex Mound								
MW-1	3.0	-0.4	-0.4		-0.6	-0.6	-0.7	-0.7	
MW-2	0.0	-2.9	-2.6		-2.8	-2.9	-3.0	-3.8	
MW-3	0.0	-1.1	-2.4		-1.9	-2.3	-2.5	-3.4	
	IGM Height (feet)	1.58	2.08		1.70	1.96	2.09	2.96	2.06
52	Mound								
MW-1	3.3	-0.91	-0.62		-0.75	0.57	-0.68	-0.44	
MW-2	0.0	-2.4	-0.6		-0.4	-0.7	-0.6	-0.7	
MW-3	0.0	-1.6	-0.8		-0.4	-0.5	-0.6	-0.4	
	IGM Height (feet)	1.10	0.08		-0.31	1.18	-0.08	0.11	0.35
57	In-Ground								
MW-1	0.0			-1.95	-1.47	-1.92	-2.20	-1.77	
MW-2	0.0			-0.5	-0.6	-0.7	-1.1	-0.7	
MW-3	0.0			-0.7	-0.8	-1.1	-1.3	-1.0	
	IGM Height (feet)			-1.34	-0.77	-1.00	-1.00	-0.90	-1.00
75	Mound								
MW-1	3.0		-0.29		-0.87	-0.97			
MW-2	0.0		-1.37		-1.95	-1.99			
MW-3	0.0		-2.28		-2.13	-1.80			
MW-4									
	IGM Height (feet)		1.54		1.17	0.93			1.21
82	Mound								
MW-1	2.3		-0.78		-1.47	-0.67	0.10		
MW-2	0.0		-1.45		-1.74	-1.78	-2.13		
MW-3	0.0		-1.49		-1.55	-1.85	-2.31		
	IGM Height (feet)		0.69		0.18	1.15	2.32		1.08
83	Mound								
MW-1	3.0					-1.00		-0.84	
MW-2	0.0					-1.83		-2.65	
MW-3	0.0					-1.12		-> 4.00	
	IGM Height (feet)					0.48		2.49	1.48
85	Mound								
MW-1	2.0			0.30			-0.95	-1.17	
MW-2	0.0			-3.03			-3.75	-3.75	
MW-3	0.0			-2.28			-1.79	-2.15	
	IGM Height (feet)			2.96			1.82	1.78	2.19
90	Mound								
MW-1	2.7			-0.53	-1.02	-0.84			
MW-2	0.0			-2.77	-2.44	-2.67			
MW-3	0.0			-3.28	-3.24	-3.45			
	IGM Height (feet)			2.49	1.82	2.22			2.18

+ reading indicates groundwater above original grade
- reading indicates groundwater level below original grade
IGM Height = MW-1 - Average of MW-2, MW-3

Induced Groundwater Mound Schematic



U:\Projects\Addison County Wastewater\IGM diagram.xls

MW-1
Levelogger Data

Depth Below Ground Surface (feet)

0
1
2
3
4

4/19 4/21 4/23 4/25 4/27 4/29 5/1 5/3 5/5 5/7 5/9 5/11 5/13 5/15 5/17 5/19 5/21 5/23 5/25 5/27 5/29 5/31 6/2

- Site 7
- Site 40
- Site 43
- Site 46
- Site 48
- Site 49
- Site 52
- Site 57
- Site 75
- Site 82
- Site 83
- Site 90

Addison County Wastewater Study

Groundwater Quality Results

Site and Well	System Type	Date Sampled	Conductivity	Temperature	Total Coliform	E. Coli	TKN	Ammonia	Nitrate	Nitrite	Dissolved Phosphorous	Total Phosphorous
			Umhos	Celcius	Count/100 ml	Count/100ml	mg/l	mg/l as N	mg/l as N	mg/l as N	mg/l	mg/l
40	In-Ground											
MW-1		5/31/2007	635	11.5								
MW-2		5/31/2007	652	9.8	270	< 10	1.23	0.183	4.27	0.08	< 0.005	0.227
MW-3			558	8.3								
49	Advantex Mound											
MW-1												
MW-2			1520	11.4								
MW-3		5/31/2007	1817	11.8	990	< 10					< 0.005	
52	Mound											
MW-1		5/28/2007	755	12.4		<100	1.97	0.351	4.29	< 0.02	0.274	4.46
MW-2		5/28/2007	771	11.2	> 24200	< 10	1.60	0.456	0.179	< 0.02	< 0.05	0.426
MW-3			810	10.6								
57	In-Ground											
MW-1		5/31/2007	2180	13.4	> 24200	12000	13.40	12.7	0.96	0.348	0.175	0.508
MW-2			960	11.7								
MW-3		5/31/2007	1304	16.5		390	7.90	4.06	< 0.2	< 0.2	0.009	0.937
75	Mound											
MW-1												
MW-2			1220	10.2								
MW-3		5/28/2007	2013	10.4								
82	Mound											
MW-1		5/28/2007	971	12.3		2800	11.00	5.43	34.2	< 0.2	4.73AA	7.66
MW-2		5/28/2007	966	11.6	810	< 10	1.34	0.232	23.9	0.121	0.013M-	0.604
MW-3			1053	10								
83	Mound											
MW-1												
MW-2			2668	11.4								
MW-3		5/31/2007	2768	12.5	> 24200	< 10	0.63	0.120	1.73	< 0.2	0.008	0.454
85	Mound											
MW-1		6/7/2007	412	13.2		> 24200	30.10	14.3	0.284	0.238	0.018	6.7
MW-2												
MW-3		6/7/2007	525	13.2		< 10	0.99	0.456	2.71	0.035	< 0.005	0.704

'"M-" indicates Laboratory Fortified Matrix analysis indicates there may be a negative interference

'"AA" indicates a preserved sample was filtered for analysis

APPENDIX 3

Heindel & Noyes, Inc.
P.O. Box 4503 Burlington, VT 05406-4503

- Consulting Hydrogeologists
- Engineers
- Environmental Scientists

Voice 802-658-0820/Fax 802-860-1014

Well Installation Soil Logs:

Addison County Wastewater Sites
27 private residencies
Addison County, Vermont

These wells were dug using a hand auger between April 17 and May 8, 2007. Soils were logged by Z. Swander. Also present: S. LaRosa, C. Riepe, M. Miller, and C. Aldrich. Conditions varied greatly from mid 30's to mid 70's, snow and rain occurred on several sites and ground surface was nearly saturated at most locations.

Abbreviations: GW = Groundwater; RMFs = Redoximorphic features (mottles, unless otherwise noted); SHWT = Seasonal high water table; NGWTD = No groundwater to depth; NBRTD = No bedrock to depth.

Site 7:

MW-1	
0 - 6"	Loamy topsoil with strong odor throughout;
6" - 12"	Leach field stone, surcharged with water;
12" - 18"	Black, silty, very fine sand;
18" - 36"	Grey/green, silty loam (Till derived), and including lots of stone.
MW-2	
0 - 10"	Loamy topsoil;
10" - 26"	Fine sand, saturated, gray/green, some mottling, stone;
26" - 36"	Fine sand, saturated, gray/green, some mottling, lots of stone.
MW-3	
0 -43"	Silt loam, black, organic-rich, roots

Site 11:

MW-1	
0 - 24"	Odor, rocks, roots, fine grained sandy loam;
24" - 36"	Saturated, odor, rocks, roots, fine grained sandy loam with pebbles;
36" - 39"	Large pebbles-cobbles.
MW-2	
0 - 12"	Fine sandy loam, roots, blocky, some mottling, light brown;
12" - 39"	Rounded cobbles;
39" - 45"	Fine sand, firm, blocky, saturated.
MW-3	
0 - 10"	Very fine sand, roots, light brown, mottled, firm;
10" - 18"	Saturated, very fine sand, roots, light brown, mottled, firm;
18" - 39"	Pebbles, liner, no odor.

Well Installation Soil Logs:

Addison County Wastewater Sites
27 private residencies
Addison County, Vermont

Site 13:

MW-1	
0 - 4”	Silty clay, brown topsoil with roots. Friable, blocky structure, slightly mottled;
4” - 18”	A.A. w/ less roots, increasing secondary permeability, mottled;
18” - 29”	Standing water, good mottling, no odor;
29” - 45”	Dry, blocky, silt loam;
45” - 54”	Wet, blocky, no odor;
54” - 57”	Sand material fill;
57” - 66”	Silt loam.
MW-2	
0 - 6”	Grey/Brown, silty clay topsoil, strong blocky structure, firm, no odor, saturated at 6”;
6” - 36”	Brown, silty clay, blocky, very firm, till derived, mottled from 1-1.5’. Drier with depth-till.
MW-3	
0 - 9”	Topsoil, A.A.
9” - 38”	Grey/Brown, clay-silt topsoil, strong blocky structure, firm, no odor, saturated at 6”; Till derived, brown clay-silt w/ pebbles, dry, compact.

Site 18:

MW-1	
0 - 18”	Topsoil, loam, dark brown-gray. Filter fabric at 1.5’;
18” - 36”	Amalgamated medium-coarse sand w/ very faint odor;
36” - 40”	A.A., saturated with water;
40” - 52”	Blocky, brown, highly mottled, sandy silt loam.
MW-2	
0 - 5”	Light brown clay, firm, roots;
5” - 26”	Medium brown, very fine sandy loam, friable (firmer with depth), slight odor, blocky;
26” - 36”	Saturated, very fine sandy loam w/ pebbles, odor, blocky, roots;
36” - 39”	Silty clay, roots, brown, saturated.
MW-3	
0 - 5”	Light brown clay, firm w/ roots;
5” – 24”	Medium brown, very fine sandy loam, friable (firmer with depth), slight odor, blocky;
24” - 36”	Very fine sandy loam, light brown, saturated, roots, odor, pebbles;
36” - 39”	A.A., highly mottled.

Site 25:

MW-1	
0 - 12”	Roots, blocky, firm, some stone, dark brown, very fine silt;
12” - 41”	Amalgamated, fine-medium, light brown sand;
41” - 52”	Dark brown, mottled, firm, very fine sandy loam;
52” - 63”	Dark brown clay. Thin layer of saturated coarse sandy loam w/ no odor at bottom (Could not determine depths.);
63” - 68”	Water surcharge, and mottled clay.
MW-2	
0 - 10”	Dark brown silty loam, blocky, lots of roots, and organics;
10” - 14”	Graded fine-medium sand w/ pebbles, light brown, but increasingly dark with depth;
14” - 27”	Dark brown silty loam, firm, blocky, mottled, slight odor, moist;
27” - 36”	A.A., saturated, roots, lighter brown;

Well Installation Soil Logs:

Addison County Wastewater Sites
27 private residencies
Addison County, Vermont

36" - 41"	A.A., heavy odor;
41" - 44"	Odor, weak red sandstone, found in soils, highly mottled.
MW-3	
0 - 12"	Roots, blocky, dry, firm, fine-very fine sand.
1' - 38"	Saturated, light brown fine sandy loam, roots, no odor.
MW-4	Not accurately recorded with split spoon.
	Site 28
MW-1	
0 - 18"	Very fine sand , friable, blocky, mottled, roots, increasing clay with depth;
18" - 24"	Sand, odor;
24" -	Gravel, odor.
MW-2	
0 - 12"	Roots, mottled, amalgamated very fine sand and silt, hard, blocky;
12" - 24"	Sandy loam, mottled, blocky, firm;
24" - 50"	Moist, mottled, soft, blocky, very fine sand, dark brown, odor.
MW-3	
0 - 18"	Medium brown, blocky, loam;
18" - 39"	A.A. mottled, dry.
	Site 40
MW-1	
0 - 18"	Lots of shale, medium brown silt, roots, granular;
18" - 30"	Moist, mottled, silty clay, light brown, chunk s of shale and quartzite, very hard (till);
30" - 33"	Water surcharged, clay, light brown;
33" - 36"	Dark brown till (mostly clay), mottled, dark gray, platey, saturated, faint odor, hard.
MW-2	
0 - 8"	Surface saturated, roots, dark brown, silt, odor, granular;
8" - 45"	Light brown/grey, mottled, silty clay, blocky, some roots, shale, very hard.
MW-3	
0 - 30"	Lots of shale, dark brown silt, roots, granular, firm. Water at 1.5';
30" - 46"	Light brown/grey, mottled, blocky, silty clay, no odor, shale, roots, very hard.
	Site 43
MW-1	
0 - 17"	Silt, medium brown, roots, minor mottling, firm;
17" - 36"	Sand, saturated at 2', odor, unconsolidated;
36" - 39"	Silty loam that transitions to clay, blocky, mottled.
MW-2	
0 - 3"	Surface saturated, mottled, blocky. Loam, medium brown, roots;
3" - 30"	Silty loam, medium brown, faint odor, blocky, mottled, 2nd saturation at 17";
30" - 48"	Light brown clay, blocky mottled.
MW-3	
0 - 31"	Surface saturated, firm, medium brown, loam, roots, mottled, blocky, faint odor;
31" - 48"	Light brown silty loam, unconsolidated, odor.

Well Installation Soil Logs:

Addison County Wastewater Sites
27 private residencies
Addison County, Vermont

	Site 46
MW-1	
0 - 6”	Roots, mottled, blocky, medium-brown clay;
6” - 24”	Medium sand, saturated, standing water at bottom, faint odor;
24” - 42”	Clay, mottled.
MW-2	
0 - 6”	Medium brown, silty loam, blocky, roots, mottled;
6” - 30”	Light brown clay;
30” - 42”	Silty loam, blocky, saturated.
MW-3	
0 - 6”	Surface saturated, brown, silty loam, roots mottling, blocky firm;
6” - 18”	Hard, silt, mottled, dry, but water at bottom;
18” - 48”	Platey, clay, light brown.
MW-4	
0 - 7”	Silty loam;
7” - 36”	Stone and sand;
36” - 40”	Native clay
	Site 48
MW-1	
0 - 30”	Silty Clay, light brown, roots, blocky, odor, firm. 2’= water surcharge;
30” - 42”	Medium brown, mottled, blocky, clay;
42” - 54”	Selectively mottled, platey, clay.
MW-2	
0 - 6”	Medium brown, blocky, silt, firm, odor;
6” - 30”	Blocky, light brown, clay, odor;
30” - 38”	Saturated, mottled, blocky, clay;
38” - 40”	Platey, mottled, saturated, clay.
MW-3	
0 - 8”	Silty clay, light brown, roots, blocky, odor, firm;
8” - 12”	A.A., saturated;
12” - 30”	Blocky, mottled, clay;
30” - 38”	Brown-grey, clay;
38” - 41”	Platey, selectively mottled, clay.
	Site 49
MW-1	
0-12”	Roots, medium brown, silty loam.
12”-32”	Amalgamated fine-medium sand with some pebbles, moist, unconsolidated;
32”-36”	A.A., saturation, faint odor;
36”-46”	Clay, gray, mottled.
MW-2	
0’ - 10”	Roots, medium brown, mottled, blocky, silty loam, slight odor, increasing saturation with depth;
10” - 46”	Brown-grey, clay, structure becomes platey at 3’, and saturation decreases.
MW-3	
0 - 12”	Blocky, saturated, modeled, light brown, silty loam, roots;
12” - 42”	Light Brown clay. Water surcharge at 1.5’.

Well Installation Soil Logs:

Addison County Wastewater Sites
27 private residencies
Addison County, Vermont

	Site 50
MW-1	
0 - 9”	Medium brown, blocky, hard, loam, dry, roots;
9” - 30”	Unconsolidated sand, odor;
30” - 36”	Medium brown, hard, clay, saturated;
36” - 39”	Blocky, mottled, hard, clay.
MW-2	
0 - 18”	Grey-brown, firm, blocky, silt loam, roots;
18” - 39”	Medium brown/grey, hard (becomes softer with depth), granular, mottled clay, saturated.
MW-3	
0 - 10”	Grey-brown, blocky, hard, silty loam, roots;
10” - 18”	Clay loam, mottled, no odor;
18” - 30”	Blocky, mottled, grey-brown, clay, odor;
30” - 38”	Loam, firm, grey-brown, granular.
MW-4	
0 - 12”	Silt loam, med. Brown;
12” - 21”	Stone and sand;
21” - 36”	Fine gravel and coarse sand;
36” - 42”	Saturated, gray, blocky, mottled clay.
	Site 52
MW-1	
0 - 6”	Medium brown, minor mottling, silty clay, roots;
6” - 22”	Blocky, firm, medium brown, silt, odor;
22” - 40”	Sand, moist, odor;
40” - 54”	A.A., saturated;
54” - 60”	Grey clay.
MW-2	
0 - 6”	Surface saturated, dark brown, friable, silt, roots, odor;
6” - 24”	Grey, fine-medium, sandy loam, saturated, odor;
24” - 32”	Grey clay, modeling.
MW-3	
0 - 6”	Surface saturated, dark brown, friable, silt, odor;
6” - 18”	Mottling along roots, saturated, odor, grey, sandy loam;
18” - 36”	Blocky, mottled, odor, grey, clay.
	Site 54
MW-1	
0 - 18”	No topsoil, moss, roots, mottled, friable, silty clay, blocky, medium brown, hard;
18” - 55”	Coarse sand.
MW-2	
0 - 12”	Dark brown, hard, blocky, clay;
12” - 16”	Coarse sand;
16” - 52”	Granular, light brown, very fine sand.
MW-3	
0 - 12”	Mottled, dark brown, hard, blocky, clay;
12” - 16”	Coarse Sand
16” - 39”	Light brown, very fine sand, roots, granular, unconsolidated.

Well Installation Soil Logs:

Addison County Wastewater Sites
27 private residencies
Addison County, Vermont

	Site 55
MW-1	
0 - 8”	Topsoil, medium brown, sandy loam, roots, some mottling, no odor;
8” - 46”	Medium sand;
46” - 49”	Dark brown, organic. Possibly former soil profile buried under mound.
MW-2	
0 - 6”	Moss, roots, medium brown, sandy loam, blocky, mottled, firm;
6” - 12”	Light brown, blocky, sandy loam, saturated, roots;
12” - 29”	Gray-brown, soft, blocky, mottled, silt, saturated, water surcharge above bedrock.
MW-3	
0 - 21”	Mottled, blocky, medium brown, silty loam, bottom saturated;
21”	Bedrock.
MW-4	
0 - 6”	Topsoil and roots;
6” - 14”	Sandy loam;
14” - 24”	Moundstone;
24” - 41”	Sand.
	Site 56
MW-1	
0 - 9”	Medium brown loam;
9” - 36”	Sand and gravel;
36” - 38”	Large amounts of organics intermixed with mottled gray silt;
38” - 46”	Light brown, unconsolidated, sandy loam, no odor. Bedrock at 46”.
MW-2	
0 - 3”	Dark Brown topsoil;
3” - 5.5”	Albic horizon;
5.5” - 19”	Dark brown, silt loam, rocks, and roots;
19” - 26”	Olive-tan, fine sand, iron staining, and water over bedrock.
MW-3	
0 - 2”	Topsoil;
2” - 2.5”	Very fine, mottled light brown sand, and roots.
MW-4	
0 - 11”	Medium brown, moist, loam
11” - 18”	Moundstone;
18” - 29”	Amalgamated medium-fine, sand. Well driven in deeper, but not logged.
	Site 57
MW-1	
0 - 15”	Dark brown, hard, blocky, dry, sandy loam, friable, minimal root penetration;
15” - 24”	Leachfield stone, grey silt, mottled saturated;
24” - 45”	Grey, mottled, blocky, firm, clay, saturated.
MW-2	
0 - 12”	Dark brown, friable, blocky, soft, silt, saturated;
12” - 43”	Grey, blocky, mottled, firm, moist, clay.
MW-3	
0 - 12”	Dark brown, friable, blocky, soft, silt, saturated;
12” - 43”	Grey, blocky, mottled, firm, moist, clay.

Well Installation Soil Logs:

Addison County Wastewater Sites
27 private residencies
Addison County, Vermont

	Site 74
MW-1	
0 - 16”	Granular/Blocky. Mottled, light brown, silt clay, roots;
16” - 40”	Sand, saturated at 3’, faint odor;
40” - 55”	Medium brown, roots, prismatic/blocky, mottled silt loam, saturated, faint odor, roots.
MW-2	
0 - 12”	Medium brown, blocky, silt, roots;
12” - 31”	Mottled, light brown-grey, blocky silty clay loam, water surcharge at 31”;
31” - 53”	Light grey, mottled, blocky/prismatic, clay.
MW-3	
0 - 18”	Surface saturated, roots, blocky, medium brown silt, faint odor;
18” - 30”	Water surcharge, medium brown, blocky mottled, silty clay;
30” - 52”	Grey, mottled, blocky, silty clay.
	Site 75
MW-1	
0 - 18”	Fine sand, dark brown becomes lighter with depth, firm, roots;
18” - 36”	Coarse sand;
36” - 44”	Silt loam, dark brown, firm, granular;
44” - 52”	Hard, gray-brown, mottled, blocky, silty clay.
MW-2	
0 - 4”	Surface saturated, light brown, soft, fine sand;
4” - 18”	Medium brown, granular, firm, saturated silt, roots. Water surcharge at 18”;
18” - 39”	Prismatic, gray-brown, mottled, silty clay;
39” - 52”	Platey, hard, gray-brown, clay, minor mottling.
MW-3	
0 - 12”	Surface saturated, medium brown, blocky, firm silt, roots;
12” - 44”	Prismatic, gray-brown, hard, silty, mottled clay;
44” - 47”	Light brown, platey, mottled, hard, clay.
MW-4	
0 - 20”	Light brown fine sand, roots, soft, blocky;
20” - 34”	Moundstone;
34” - 44”	Coarse sand;
44” - 48”	Silty Clay.
	Site 77
MW-1	
0 - 12”	Topsoil;
12” - 49”	Sand:
49” - 60”	Dark brown, moist, silty clay.
MW-2	
0 - 39”	Dark brown, mottled, firm silt with minor clay. First few inches is topsoil with roots.
MW-3	
0 - 5”	Topsoil;
5” - 30”	Clay, light brown, mottled, hard, no structure;
30” - 40”	Brown-grey, mottled, dense, blocky, clay.
MW-4	
0 - 14”	Brown, silty clay;
14” - 23”	Mounstone;
23” - 51”	Mound sand;
51” - 57”	Silty clay.

Well Installation Soil Logs:

Addison County Wastewater Sites
27 private residencies
Addison County, Vermont

	Site 79
MW-1	
0 - 14.5”	Fine sand, granular, soft;
14.5” - 32”	Sand;
32” - 42	Dark brown, minor mottling, silt loam.
MW-2	
0 - 9”	Dark brown loam, and topsoil;
9” - 31”	Dark brown, blocky, silty clay loam, moisture, ledge.
MW-3	
0 - 8”	Topsoil, roots;
8” - 36”	Fine sandy loam with minor mottling and moisture at 12”;
36” - 39”	Blocky, mottled, saturated.
MW-4	
0 - 3”	Topsoil;
3” - 18”	Very fine sand, moundstone. Steel well drove into mound, soil not logged.
	Site 80
MW-1	
0 - 8”	Medium brown, blocky, friable, hard, very fine sandy loam, roots;
8” - 34”	Sand, moist;
34” - 46”	Grey-brown, firm, mottled, hard, blocky, moist.
MW-2	
0 - 10”	Light brown, friable, blocky, hard silt, roots;
10” - 24”	Light brown, firm, moist, sandy loam;
24” - 44”	Brown silty clay, moist.
MW-3	
0 - 12”	Silt loam, friable, hard, blocky, medium brown, roots;
12” - 34”	Silt, light brown, blocky, hard, mottled;
34” - 46”	Silty clay, light brown, soft, moist.
	Site 82
MW-1	
0 - 3”	Dark brown topsoil;
3” - 12”	Light brown loam, roots to 6”;
12” - 27”	Amalgamated medium-course sand, water surcharge at 28”;
27” - 36”	Dark brown, soft, clay loam;
36” - 55”	Light grey, firm, blocky, mottled, silty clay.
MW-2	
0 - 6”	Medium brown loam, roots;
6” - 35”	Gray-brown, firm, modeled, silty clay;
35” - 40”	Clay.
MW-3	
0 - 6”	Medium brown, sandy loam, roots;
6” - 36”	Mottled, blocky, grey-brown, silt loam;
36” - 43”	Hard, grey clay.
MW-4	
0 - 7”	Data lost.
7” - 36”	
36” - 40”	

Well Installation Soil Logs:

Addison County Wastewater Sites
27 private residencies
Addison County, Vermont

	Site 83
MW-1	
0 - 12”	Light brown, friable moist, blocky, mottled silt, roots;
12” - 36”	Medium sand;
36” - 51”	Blocky, mottled, dark grey silt with minor clay.
MW-2	
0 - 30”	Medium brown, friable, granular silt, roots;
30” - 42”	Grey, granular, mottled, very fine sandy loam.
MW-3	
0 - 21”	Surface saturated, medium brown, granular, firm silt, roots;
21” - 49”	Grey, mottled, blocky, hard, silt. Surcharge at top of interval, but becomes drier with depth.
	Site 84
MW-1	
0 - 18”	Dark brown, hard, blocky, friable, silt loam, roots;
18” - 28”	Fine-medium sand, light grey-brown, unconsolidated;
28” - 36”	Firm, dark brown, silt loam;
36” - 42”	Transition to blocky, hard;
42” - 56”	Clay, mottled, medium brown, coarser grains intermixed. At 56”: water saturated, fine sandy loam.
MW-2	
0 - 12”	Firm, fine, dark brown, moist, roots, mottled, silt loam;
12” - 23”	Unconsolidated, light brown, mottled, sand;
23” - 38”	Saturated, mottled silt loam, slight odor;
38” - 47”	Firm, moist, fine sand, color changes to grey.
MW-3	
0 - 6”	Moist, blocky, dark brown, silt loam, roots;
6” - 15”	Blocky, moist, very fine sand, medium brown;
15” - 20”	Saturated, light brown, A.A.;
20” - 30”	Silt loam, mottled, firm, blocky, slight odor;
30” - 39”	Light brown mottled clay. Bottom saturated.
MW-4	
0 - 12”	Topsoil;
12” - 24”	Moundstone;
24” - 45”	Coarse sand;
45” - 55”	Dry, native clay-silt.
	Site 85
MW-1	
0 - 24”	Medium brown, saturated, sandy loam;
24” - 36”	Grey-brown silt loam, saturated;
36” - 42”	Grey saturated silt loam.
MW-2	
0 - 12”	Saturated, light brown, silt loam;
12” - 30”	Light brown, silt loam, wet;
30” - 46”	Saturated blocky, gray, soft, silt loam with some gravel.
MW-3	
0 - 6”	Dry, medium brown, silt loam;
6” - 30”	Saturated, light brown, silty clay loam;
30” - 38”	Silty clay, brown, mottled.

Well Installation Soil Logs:

Addison County Wastewater Sites
27 private residencies
Addison County, Vermont

	Site 90
MW-1	
0 - 30”	Dry, blocky, dark brown, friable, hard, sandy loam, roots;
30” - 32”	Coarse sand, saturated;
32” - 43”	Blocky, extremely dark brown silt, hard, mottled.
MW-2	
0 - 18”	Sandy loam, hard, blocky, medium brown, roots;
18” - 46”	Grey-brown, blocky, clay.
MW-3	
0 - 18”	Brown, friable, dry, silty clay, roots;
18 - 48”	Gray-brown, blocky, hard, silty clay, mottled.

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APPENDIX 4

ENDYNE, INC.

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

LABORATORY REPORT

Heindel & Noyes
PO Box 4503,
Burlington, VT 05406-4709
Attn: Steve LaRosa

PROJECT: Addison County Wastewater
ORDER ID: 54618
RECEIVE DATE: May 30, 2007
REPORT DATE: June 12, 2007

Enclosed please find the results of the analyses performed for the samples referenced on the attached chain of custody. Different groups of analyses may be reported under separate cover.

All samples were prepared and analyzed by requirements outlined in the referenced methods and within the specified holding times.

All instrumentation was calibrated with the appropriate frequency and verified by the requirements outlined in the referenced methods.

Blank contamination was not observed at levels affecting the analytical results.

Analytical method precision and accuracy was monitored by laboratory control standards which include matrix spike, duplicate and quality control analyses. These standards were determined to be within established laboratory method acceptance limits, unless otherwise noted.

Reviewed by,

Harry B. Locker, Ph.D.
Laboratory Director

ELAP 1263

ENDYNE, INC.

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

LABORATORY REPORT

CLIENT: Heindel & Noyes
PROJECT: Addison County Wastewater
REPORT DATE: June 12, 2007

ORDER ID: 54618
DATE RECEIVED: May 30, 2007
SAMPLER: ZS

Ref. Number: 300206 | Site: 57-3 | Date Sampled: May 30, 2007 | Time: 2:30 PM

Parameter	Result	Unit	Method	Analysis Date	Analyst
E. coli	390.	MPN/100 ml	SM 9223B	5/30/07 5:00 PM	168
Nitrogen, Ammonia	4.06	mg/L	EPA 350.1	6/6/07	101
Nitrogen, Nitrite	< 0.200	mg/L	EPA 300.0	5/30/07 6:50 PM	168
Nitrogen, Nitrate	< 0.200	mg/L	EPA 300.0	5/30/07 6:50 PM	168
Nitrogen, T. Kjeldahl	7.90	mg/L	EPA 351.2	6/5/07	101
Total Phosphorous	0.937	mg/L	EPA 365.1	6/8/07	101
Dissolved Phosphorous	0.009	mg/L	EPA 365.1	6/8/07	101

ELAP 11263

ENDYNE, INC.

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333

CHAIN-OF-CUSTODY-RECORD

92714

Special Reporting Instructions:

Project Name:	Reporting Address:	Billing Address:
Addison County	H & N	
Endyne Order ID: (Lab Use Only) 54618	Company: H & N	Sampler Name: Zach Swander
-O / -I / -S	Contact Name/Phone #:	Phone #:

Ref # (Lab Use Only)	Sample Identification	Matrix	GRAB	COMP	Date/Time	Sample Containers No.	Sample Containers Type/Size	Field Results/Remarks	Analysis Required	Sample Preservation	Rush
	57-1	H_2O	↓		5/30/07 ~~2:30~~	1	plastic 1 gal mL	ecoli	fecal coliform ~~H_2SO_4~~		no
	↓	H_2O			↓	1	glass 40z		dissolved phosphorous H_2SO_4		↓
		H_2O	↓		↓	1	glass 80z			H_2SO_4	
								Total phosphorous Nitrite Nitrate Ammonia TKN			

Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time
Zach Swander	4:30 5/30/07			Florucci	5/30/07 4:45

New York State Project: Yes _____ No _____

Requested Analyses

1	pH	6	TKN	11	Total Solids	16	Sulfate	21	1664 TPH/FOG	26	8270 PAH
2	Chloride	7	Total P	12	TSS	17	Coliform (Specify)	22	8015 GRO	27	PP13 Metals
3	Ammonia N	8	Total Diss. P	13	TDS	18	COD	23	8015 DRO	28	RCRA8 Metals
4	Nitrite N	9	BOD	14	Turbidity	19	8021B	24	8260/8260B	29	
5	Nitrate N	10	Alkalinity	15	Conductivity	20	8010/8020	25	8270 B/N or Acid	30	
31	Metals (As Is, Total, Diss.) Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Tl, V, Zn										
32	TCLP (Specify: volatiles, semi-volatiles, metals, pesticides, herbicides)					33					
34	Other										

LAB USE ONLY
Delivery: Client
Temp: 4.6°C
Comment:

(White, Yellow - Laboratory / Pink - Client)

ENDYNE, INC.

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

LABORATORY REPORT

Heindel & Noyes
PO Box 4503,
Burlington, VT 05406-4709
Attn: Steve LaRosa

PROJECT: Addison County Wastewater
ORDER ID: 54694
RECEIVE DATE: June 1, 2007
REPORT DATE: June 21, 2007

Enclosed please find the results of the analyses performed for the samples referenced on the attached chain of custody. Different groups of analyses may be reported under separate cover.

All samples were prepared and analyzed by requirements outlined in the referenced methods and within the specified holding times.

All instrumentation was calibrated with the appropriate frequency and verified by the requirements outlined in the referenced methods.

Blank contamination was not observed at levels affecting the analytical results.

Analytical method precision and accuracy was monitored by laboratory control standards which include matrix spike, duplicate and quality control analyses. These standards were determined to be within established laboratory method acceptance limits, unless otherwise noted.

M- indicates Laboratory Fortified Matrix analysis indicates there may be a negative interference.

Reviewed by,

Harry B. Locker, Ph.D.
Laboratory Director

ELAP 1 263

ENDYNE, INC.

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

LABORATORY REPORT

CLIENT: Heindel & Noyes
PROJECT: Addison County Wastewater
REPORT DATE: June 21, 2007

ORDER ID: 54694
DATE RECEIVED: June 1, 2007
SAMPLER: ZS

Ref. Number: 300449 | Site: 40 | Date Sampled: June 1, 2007 | Time: 12:00 PM

Parameter	Result	Unit	Method	Analysis Date	Analyst
Nitrogen, Ammonia	0.183	mg/L	EPA 350.1	6/14/07	101
Nitrogen, Nitrite	0.080	mg/L	EPA 300.0	6/1/07 10:10 PM	168
Nitrogen, Nitrate	4.27	mg/L	EPA 300.0	6/1/07 10:10 PM	168
Nitrogen, T. Kjeldahl	1.23	mg/L	EPA 351.2	6/12/07	101
Total Phosphorous	0.227	mg/L	EPA 365.1	6/8/07	101
Dissolved Phosphorous	< 0.005	mg/L	EPA 365.1	6/15/07	101
Total Coliform	270.	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168
E. coli	< 10.	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168

Ref. Number: 300450 | Site: 52-1 | Date Sampled: June 1, 2007 | Time: 1:00 PM

Parameter	Result	Unit	Method	Analysis Date	Analyst
Nitrogen, Ammonia	0.351	mg/L	EPA 350.1	6/14/07	101
Nitrogen, Nitrite	< 0.020	mg/L	EPA 300.0	6/1/07 10:30 PM	168
Nitrogen, Nitrate	4.29	mg/L	EPA 300.0	6/1/07 10:30 PM	168
Nitrogen, T. Kjeldahl	1.97	mg/L	EPA 351.2	6/12/07	101
Total Phosphorous	4.46	mg/L	EPA 365.1	6/8/07	101

Ref. Number: 300451 | Site: 52-2 | Date Sampled: June 1, 2007 | Time: 1:00 PM

Parameter	Result	Unit	Method	Analysis Date	Analyst
Nitrogen, Ammonia	0.456	mg/L	EPA 350.1	6/14/07	101
Nitrogen, Nitrite	< 0.020	mg/L	EPA 300.0	6/1/07 10:50 PM	168
Nitrogen, Nitrate	0.179	mg/L	EPA 300.0	6/1/07 10:50 PM	168
Nitrogen, T. Kjeldahl	1.60	mg/L	EPA 351.2	6/12/07	101
Total Phosphorous	0.426	mg/L	EPA 365.1	6/8/07	101
Dissolved Phosphorous	< 0.050	mg/L	EPA 365.1	6/15/07	101
Total Coliform	> 24,200.	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168
E. coli	< 10	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168

ENDYNE, INC

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

Ref. Number: 300452 | Site: 82-2 | Date Sampled: June 1, 2007 | Time: 1:40 PM

Parameter	Result	Unit	Method	Analysis Date	Analyst
Nitrogen, Ammonia	0.232	mg/L	EPA 350.1	6/14/07	101
Nitrogen, Nitrite	0.121	mg/L	EPA 300.0	6/1/07 11:10 PM	168
Nitrogen, Nitrate	23.9	mg/L	EPA 300.0	6/1/07 11:10 PM	168
Nitrogen, T. Kjeldahl	1.34 M-	mg/L	EPA 351.2	6/12/07	101
Total Phosphorous	0.604	mg/L	EPA 365.1	6/8/07	101
Dissolved Phosphorous	0.013M-	mg/L	EPA 365.1	6/15/07	101
Total Coliform	810.	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168
E. coli	< 10.	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168

Ref. Number: 300453 | Site: 49-3 | Date Sampled: June 1, 2007 | Time: 2:30 PM

Parameter	Result	Unit	Method	Analysis Date	Analyst
Dissolved Phosphorous	< 0.005	mg/L	EPA 365.1	6/15/07	101
Total Coliform	990.	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168
E. coli	< 10.	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168

Ref. Number: 300454 | Site: 83-3 | Date Sampled: June 1, 2007 | Time: 10:30 AM

Parameter	Result	Unit	Method	Analysis Date	Analyst
Nitrogen, Ammonia	0.120	mg/L	EPA 350.1	6/14/07	101
Nitrogen, Nitrite	< 0.200	mg/L	EPA 300.0	6/1/07 11:50 PM	168
Nitrogen, Nitrate	1.73	mg/L	EPA 300.0	6/1/07 11:50 PM	168
Nitrogen, T. Kjeldahl	0.631	mg/L	EPA 351.2	6/12/07	101
Total Phosphorous	0.454	mg/L	EPA 365.1	6/8/07	101
Dissolved Phosphorous	0.008	mg/L	EPA 365.1	6/8/07	101
Total Coliform	> 24,200	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168
E. coli	< 10.	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168

ELAP 1 263

ENDYNE, INC.

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

Ref. Number: 300455 Site: 57-1 Date Sampled: June 1, 2007 Time: 11:30 AM

Parameter	Result	Unit	Method	Analysis Date	Analyst
Nitrogen, Ammonia	12.7	mg/L	EPA 350.1	6/14/07	101
Nitrogen, Nitrite	0.348	mg/L	EPA 300.0	6/2/07 12:10 AM	168
Nitrogen, Nitrate	0.960	mg/L	EPA 300.0	6/2/07 12:10 AM	168
Nitrogen, T. Kjeldahl	13.4	mg/L	EPA 351.2	6/12/07	101
Total Phosphorous	0.508	mg/L	EPA 365.1	6/8/07	101
Dissolved Phosphorous	0.175	mg/L	EPA 365.1	6/8/07	101
Total Coliform	> 24,200.	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168
E. coli	12,000.	MPN/100 ml	SM 9223B	6/1/07 4:45 PM	168

ELAP 11263

ENDYNE, INC.

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333

CHAIN-OF-CUSTODY-RECORD

92744

Special Reporting Instructions:

Project Name:	Reporting Address:	Billing Address:
Addison County	H & N	
Endyne Order ID: (Lab Use Only) 54694	Company: H & N	Sampler Name: Zach Swander
-O / -I / -S	Contact Name/Phone #:	Phone #:

Ref# (Lab Use Only)	Sample Identification	Matrix	GRAB	COMP	Date/Time	# Containers	Type/Size	Field Results/Remarks	Analysis Required	Sample Preservation	Rush
449	40	H_2O	X		6/1/07 12:00	1	plastic 16 oz				
	40						glass 4 oz		dissolved phosphorus	H_2SO_4	
	40						150 mL plastic	total phosphorus	fecal coliform	provided	
	52-1				1:00		16 oz plastic	nitrite			
	52-2						glass 4 oz	nitrate	dissolved phosphorus	H_2SO_4	
	52-2						16 oz. plastic	TKN			
	52-2						150 mL plastic	ammonia	fecal coliform	provided	
	82-2				1:40		150 mL plastic		fecal coliform	provided	
	82-2						4 oz glass		dissolved phosphorus	H_2SO_4	
	82-2						16 oz plastic				

Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time
Zach Swander	3:00 6/1/07	Florence	6/1/07 3:55		

New York State Project: Yes ____ No ✓

Requested Analyses

1	pH	6	TKN	11	Total Solids	16	Sulfate	21	1664 TPH/FOG	26	8270 PAH
2	Chloride	7	Total P	12	TSS	17	Coliform (Specify)	22	8015 GRO	27	PP13 Metals
3	Ammonia N	8	Total Diss. P	13	TDS	18	COD	23	8015 DRO	28	RCRA8 Metals
4	Nitrite N	9	BOD	14	Turbidity	19	8021B	24	8260/8260B	29	
5	Nitrate N	10	Alkalinity	15	Conductivity	20	8010/8020	25	8270 B/N or Acid	30	

31 Metals (As Is, Total, Diss.) Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Tl, V, Zn

32 TCLP (Specify: volatiles, semi-volatiles, metals, pesticides, herbicides) 33

34 Other

LAB USE ONLY
Delivery: Client
Temp:
Comment:
fecal coliform changed to 17+ as per 25 6/1/07 ag

(White, Yellow - Laboratory / Pink - Client)

ENDYNE, INC.
160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333

CHAIN-OF-CUSTODY-RECORD

92745

Special Reporting Instructions:

Project Name:	Reporting Address:	Billing Address:
Addison County	H & N	
Endyne Order ID: (Lab Use Only) 54694 (-O / -I / -S)	Company: H & N	Sampler Name:
	Contact Name/Phone #:	Phone #:

Ref # (Lab Use Only)	Sample Identification	Matrix	Grab	Comp	Date/Time	Sample Containers: No.	Type/Size	Field Results/Remarks	Analysis Required	Sample Preservation	Rush
	49-3	H_2O			6/1/07 2:30	1	150 mL plastic		fecal coliform	provided	
	49-3					1	4 oz glass	dissolved phosphorus		H_2SO_4	
	83-3				10:30	2	32 oz glass	TKN			
	83-3					1	150 mL plastic	Ammonia	fecal coliform	provided	
	83-3					1	4 oz glass	Nitrite	dissolved phosphorus	H_2SO_4	
	57-3				* 11:30	1	16 oz plastic	Nitrate			
	57-3					1	150 mL plastic	~~total phosphorus~~	fecal coliform	provided	
	57-3					1	4 oz glass		dissolved phosphorus	H_2SO_4	
	~~49-3~~				2:30	1					

Relinquished by:	Date/Time	Received by:	Date/Time	~~Received by:~~	Date/Time
Zach Swander	3:00 6/1/07	[signature]	6/1/07 4:05		

New York State Project: Yes _____ No X

Requested Analyses

1	pH	6	TKN	11	Total Solids	16	Sulfate	21	1664 TPH/FOG	26	8270 PAH
2	Chloride	7	Total P	12	TSS	17	Coliform (Specify)	22	8015 GRO	27	PP13 Metals
3	Ammonia N	8	Total Diss. P	13	TDS	18	COD	23	8015 DRO	28	RCRA8 Metals
4	Nitrite N	9	BOD	14	Turbidity	19	8021B	24	8260/8260B	29	
5	Nitrate N	10	Alkalinity	15	Conductivity	20	8010/8020	25	8270 B/N or Acid	30	
31	Metals (As Is, Total, Diss.) Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Tl, V, Zn										
32	TCLP (Specify: volatiles, semi-volatiles, metals, pesticides, herbicides)					33					
34	Other										

LAB USE ONLY
Delivery:
Temp:

Comment:
fecal coliform changed to 17+ as per ZS 6/1/07

(White, Yellow - Laboratory / Pink - Client)

ENDYNE, INC.

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

LABORATORY REPORT

Heindel & Noyes
PO Box 4503,
Burlington, VT 05406-4709
Attn: Steve LaRosa

PROJECT: Addison County Wastewater
ORDER ID: 54829
RECEIVE DATE: June 7, 2007
REPORT DATE: June 25, 2007

Enclosed please find the results of the analyses performed for the samples referenced on the attached chain of custody. Different groups of analyses may be reported under separate cover.

All samples were prepared and analyzed by requirements outlined in the referenced methods and within the specified holding times.

All instrumentation was calibrated with the appropriate frequency and verified by the requirements outlined in the referenced methods.

Blank contamination was not observed at levels affecting the analytical results.

Analytical method precision and accuracy was monitored by laboratory control standards which include matrix spike, duplicate and quality control analyses. These standards were determined to be within established laboratory method acceptance limits, unless otherwise noted.

Reviewed by,

Harry B. Locker. Ph.D.
Laboratory Director

ENDYNE, INC

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

LABORATORY REPORT

CLIENT: Heindel & Noyes
PROJECT: Addison County Wastewater
REPORT DATE: June 25, 2007

ORDER ID: 54829
DATE RECEIVED: June 7, 2007
SAMPLER: ZS

Ref. Number: 300825 | Site: 85-1 | Date Sampled: June 7, 2007 | Time: 10:30 AM

Parameter	Result	Unit	Method	Analysis Date	Analyst
E. coli	> 24,200.	MPN/100 ml	SM 9223B	6/7/07 2:45 PM	503
Dissolved Phosphorous	0.018	mg/L	EPA 365.1	6/20/07	101

Ref. Number: 300826 | Site: 85-3 | Date Sampled: June 7, 2007 | Time: 10:30 AM

Parameter	Result	Unit	Method	Analysis Date	Analyst
E. coli	< 10.	MPN/100 ml	SM 9223B	6/7/07 2:45 PM	503
Nitrogen, Ammonia	0.456	mg/L	EPA 350.1	6/22/07	101
Nitrogen, Nitrite	0.035	mg/L	EPA 300.0	6/7/07 9:03 PM	168
Nitrogen, Nitrate	2.71	mg/L	EPA 300.0	6/7/07 9:03 PM	168
Nitrogen, T. Kjeldahl	0.991	mg/L	EPA 351.2	6/19/07	101
Total Phosphorous	0.704	mg/L	EPA 365.1	6/20/07	101
Dissolved Phosphorous	< 0.005	mg/L	EPA 365.1	6/20/07	101

ELAP 11263

≡ ENDYNE, INC.
160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333

CHAIN-OF-CUSTODY-RECORD

84770

Special Reporting Instructions:

Project Name:	Reporting Address:	Billing Address:
Addison County	H & N	
Endyne Order ID: (Lab Use Only) 54829 (-O / -I / -S)	Company: H & N Contact Name/Phone #:	Sampler Name: Zach Swander Phone #:

Ref # (Lab Use Only)	Sample Identification	Matrix	GRAB	COMP	Date/Time	Sample Containers No.	Sample Containers Type/Size	Field Results/Remarks	Analysis Required	Sample Preservation	Rush
	85-1	H_2O			6/7/07, 10:50	1	150 mL plastic		fecal coliform	provided	
	85-1	H_2O				1	40z glass		dissolved phosphorus	H_2SO_4	
	85-3	H_2O				1	150 mL plastic		fecal coliform	provided	
	85-3	H_2O				1	40z glass		dissolved phosphorus	H_2SO_4	
	85-3	H_2O	↓		↓	1	1L glass	TKN Ammonia Nitrite Nitrate Total Phosphorus	←	none	

Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time
Zach Swander	6/7/07 11:50				6/7/07 11:54

New York State Project: Yes _____ No _____

Requested Analyses

1	pH	6	TKN	11	Total Solids	16	Sulfate	21	1664 TPH/FOG	26	8270 PAH
2	Chloride	7	Total P	12	TSS	17	Coliform (Specify)	22	8015 GRO	27	PP13 Metals
3	Ammonia N	8	Total Diss. P	13	TDS	18	COD	23	8015 DRO	28	RCRA8 Metals
4	Nitrite N	9	BOD	14	Turbidity	19	8021B	24	8260/8260B	29	
5	Nitrate N	10	Alkalinity	15	Conductivity	20	8010/8020	25	8270 B/N or Acid	30	
31	Metals (As Is, Total, Diss.) Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Tl, V, Zn										
32	TCLP (Specify: volatiles, semi-volatiles, metals, pesticides, herbicides)							33			
34	Other										

LAB USE ONLY
Delivery:
Temp: 11.5°C
Comments:

(White, Yellow - Laboratory / Pink - Client)

ENDYNE, INC.

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

LABORATORY REPORT

Heindel & Noyes
PO Box 4503,
Burlington, VT 05406-4709
Attn: Steve LaRosa

PROJECT: Addison County Wastewater
ORDER ID: 54976
RECEIVE DATE: June 13, 2007
REPORT DATE: June 20, 2007

Enclosed please find the results of the analyses performed for the samples referenced on the attached chain of custody. Different groups of analyses may be reported under separate cover.

All samples were prepared and analyzed by requirements outlined in the referenced methods and within the specified holding times.

All instrumentation was calibrated with the appropriate frequency and verified by the requirements outlined in the referenced methods.

Blank contamination was not observed at levels affecting the analytical results.

Analytical method precision and accuracy was monitored by laboratory control standards which include matrix spike, duplicate and quality control analyses. These standards were determined to be within established laboratory method acceptance limits, unless otherwise noted.

Reviewed by,

Harry B. Locker, Ph.D.
Laboratory Director

ENDYNE, INC.

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

LABORATORY REPORT

CLIENT: Heindel & Noyes
PROJECT: Addison County Wastewater
REPORT DATE: June 20, 2007

ORDER ID: 54976
DATE RECEIVED: June 13, 2007
SAMPLER: ZS

Ref. Number: 301222 | Site: 85-1 | Date Sampled: June 13, 2007 | Time: 12:00 PM

Parameter	Result	Unit	Method	Analysis Date	Analyst
Nitrogen, Ammonia	14.3	mg/L	EPA 350.1	6/14/07	101
Nitrogen, Nitrite	0.238	mg/L	EPA 300.0	6/13/07 8:44 PM	168
Nitrogen, Nitrate	0.284	mg/L	EPA 300.0	6/13/07 8:44 PM	168
Nitrogen, T. Kjeldahl	30.1	mg/L	EPA 351.2	6/19/07	101
Total Phosphorous	6.70	mg/L	EPA 365.1	6/19/07	101

ELAP 1263

≡ ENDYNE, INC.
160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333

CHAIN-OF-CUSTODY-RECORD

84841

Special Reporting Instructions:

Project Name: ACWW	Reporting Address: H & N	Billing Address:
Endyne Order ID: (Lab Use Only) 54976 -O / -I / -S	Company: H & N Contact Name/Phone #:	Sampler Name: Zach Swander Phone #:

Ref.# (Lab Use Only)	Sample Identification	Matrix	GRAB	COMP	Date/Time	Sample Containers No.	Sample Containers Type/Size	Field Results/Remarks	Analysis Required	Sample Preservation	Rush
	85-1	H2O	X		12:00 6/13/07	1	1 L glass	TKN Ammonia Nitrate Nitrite TP	←	none	X 6/14

Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time
Zach Swander	1:20 6/13/07	Gloucci	6/13/07 1:20		

New York State Project: Yes _____ No _____

Requested Analyses

1	pH	6	TKN	11	Total Solids	16	Sulfate	21	1664 TPH/FOG	26	8270 PAH
2	Chloride	7	Total P	12	TSS	17	Coliform (Specify)	22	8015 GRO	27	PP13 Metals
3	Ammonia N	8	Total Diss. P	13	TDS	18	COD	23	8015 DRO	28	RCRA8 Metals
4	Nitrite N	9	BOD	14	Turbidity	19	8021B	24	8260/8260B	29	
5	Nitrate N	10	Alkalinity	15	Conductivity	20	8010/8020	25	8270 B/N or Acid	30	
31	Metals (As Is, Total, Diss.) Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Tl, V, Zn										
32	TCLP (Specify: volatiles, semi-volatiles, metals, pesticides, herbicides)							33			
34	Other										

LAB USE ONLY
Delivery: Client
Temp: 2.4/5.9°C
Comment:

(White, Yellow - Laboratory / Pink - Client)

ENDYNE, INC

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

LABORATORY REPORT

Heindel & Noyes
PO Box 4503,
Burlington, VT 05406-4709
Attn: Steve LaRosa

PROJECT Addison County Wastewater
ORDER ID: 54565
RECEIVE DATE: May 29, 2007
REPORT DATE: June 18, 2007

Enclosed please find the results of the analyses performed for the samples referenced on the attached chain of custody. Different groups of analyses may be reported under separate cover.

All samples were prepared and analyzed by requirements outlined in the referenced methods and within the specified holding times.

All instrumentation was calibrated with the appropriate frequency and verified by the requirements outlined in the referenced methods.

Blank contamination was not observed at levels affecting the analytical results.

Analytical method precision and accuracy was monitored by laboratory control standards which include matrix spike, duplicate and quality control analyses. These standards were determined to be within established laboratory method acceptance limits, unless otherwise noted.

AA indicates a preserved sample was filter for analysis.

Reviewed by,

Harry B. Locker, Ph.D.
Laboratory Director

Enclosures

ENDYNE, INC.

Laboratory Services

160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333
FAX 879-7103

LABORATORY REPORT

CLIENT: Heindel & Noyes
PROJECT: Addison County Wastewater
REPORT DATE: June 18, 2007

ORDER ID: 54565
DATE RECEIVED: May 29, 2007
SAMPLER: ZS

Ref. Number: 300072 | Site: 82-1 | Date Sampled: May 29, 2007 | Time: 2:30 PM

Parameter	Result	Unit	Method	Analysis Date	Analyst
E. coli	2,800.	MPN/100 ml	SM 9223B	5/29/07 5:20 PM	168
Nitrogen, Ammonia	5.43	mg/L	EPA 350.1	6/6/07	101
Nitrogen, Nitrite	< 0.200	mg/L	EPA 300.0	5/29/07 7:48 PM	168
Nitrogen, Nitrate	34.2	mg/L	EPA 300.0	5/29/07 7:48 PM	168
Nitrogen, T. Kjeldahl	11.0	mg/L	EPA 351.2	6/5/07	101
Total Phosphorous	7.66	mg/L	EPA 365.1	6/7/07	101
Dissolved Phosphorous	4.73 AA	mg/L	EPA 365.1	6/15/07	101

Ref. Number: 300073 | Site: 52-1 | Date Sampled: May 29, 2007 | Time: 12:30 PM

Parameter	Result	Unit	Method	Analysis Date	Analyst
E. coli	< 100.	MPN/100 ml	SM 9223B	5/29/07 5:20 PM	168
Dissolved Phosphorous	0.274	mg/L	EPA 365.1	6/7/07	101

ELAP 11263

≡ ENDYNE, INC.
160 James Brown Drive
Williston, Vermont 05495
(802) 879-4333

CHAIN-OF-CUSTODY-RECORD

92701

Special Reporting Instructions: _____

Project Name:	Reporting Address:	Billing Address:
Allison County Wastewater		
Endyne Order ID: (Lab Use Only) 54565 (-O / 1 -I / -S)	Company: Heindel & Noyes Contact Name/Phone #: Zach Swander/802-658-5428	Sampler Name: Zach Swander Phone #:

Ref # (Lab Use Only)	Sample Identification	Matrix	GRAB	COMP	Date/Time	Sample Containers No.	Sample Containers Type/Size	Field Results/Remarks	Analysis Required	Sample Preservation	Rush
	82-1	H_2O	X		2:30 PM 5/29/07	1	Glass 1/2 gal	not filtered		H_2SO_4	NO
	82-1				2:30 PM		Glass 250mL	filtered	dissolved phosphorous	H_2SO_4	
	82-1				2:30 PM		plastic 150 mL		fecal coliform	iced w/ Na Sar	
	52-1				12:30 PM		plastic 150 mL		fecal coliform		
	52-1				12:30 PM		Glass 250 mL	filtered	dissolved phosphorous	sulfuric acid	
								Total phosphorous Nitrite Nitrate Amonia TKN			

Relinquished by:	Date/Time	Received by:	Date/Time	Received by:	Date/Time
Zach Swander	5/29/07		5/29/07 4:40		

New York State Project: Yes _____ No _____

Requested Analyses

1	pH	6	TKN	11	Total Solids	16	Sulfate	21	1664 TPH/FOG	26	8270 PAH
2	Chloride	7	Total P	12	TSS	17	Coliform (Specify)	22	8015 GRO	27	PP13 Metals
3	Ammonia N	8	Total Diss. P	13	TDS	18	COD	23	8015 DRO	28	RCRA8 Metals
4	Nitrite N	9	BOD	14	Turbidity	19	8021B	24	8260/8260B	29	
5	Nitrate N	10	Alkalinity	15	Conductivity	20	8010/8020	25	8270 B/N or Acid	30	
31	Metals (As Is, Total, Diss.) Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Tl, V, Zn										
32	TCLP (Specify: volatiles, semi-volatiles, metals, pesticides, herbicides)					33					
34	Other										

LAB USE ONLY
Delivery: Client
Temp: 6.7°C
Comment:

(White, Yellow - Laboratory / Pink - Client)